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Environmental Protection Branch

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Direction de la protection de l'environnement

# SCREENING LEVEL AQUATIC ECOLOGICAL RISK ASSESSMENT STEPHENVILLE UPPER AIR STATION STEPHENVILLE, NEWFOUNDLAND

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# SCREENING LEVEL AQUATIC ECOLOGICAL RISK ASSESSMENT
# STEPHENVILLE UPPER AIR STATION
# STEPHENVILLE, NEWFOUNDLAND

**FEBRUARY 2003**

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## EXECUTIVE SUMMARY

Environment Canada, Environmental Protection Branch, Air and Toxics Issues Section, has prepared the following aquatic ecological risk assessment for Ned's Pond, Pond #2, and a marshy area (referred to in this report as the on-site marsh) on and adjacent to the Environment Canada Upper Air Station (UAS) property, Stephenville, Newfoundland.

From 1943 to 1996 the site was part of the Ernest Harmon United States Air Force (USAF) air base. During this time, the site topography was modified and several waste disposal areas were created. Two known buried waste barrel disposal areas were identified on the property near the two ponds in previous reports. Any chemicals disposed of on the property, including those potentially present in the barrel disposal areas, may have leached into the soil and/or groundwater and migrated either via surface runoff or groundwater discharge to Ned's Pond, Pond #2, and/or the on-site marsh. Due to the nature of the previous land use (primarily for military purposes), the potential parameters of concern (POCs) were determined to be petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), organochlorine pesticides, and metals.

A field program was conducted by Environment Canada in November and December, 2001. The field program involved the collection of sediment, surface water, and fish from Ned's Pond, Pond #2, and/or the on-site marsh, and three reference areas; Black Duck Pond, an unnamed 'Control Pond 2' and/or a 'reference marsh' located near Black Duck Pond. All sediment, surface water, and fish tissue and carcass samples were analysed for PAHs, PCBs, metals, organochlorine pesticides and/or TPH (not tested for in fish). In addition, surface water was analysed for general chemistry and the sediment samples were analysed for toxicity to bacteria (*Vibrio fischeri*) and amphipods (*Hyalella azteca*).

The analytical results from Ned's Pond, Pond #2 and the on-site marsh (where applicable) were compared to the analytical results from the reference areas and to applicable screening criteria where available (i.e. Canadian Council of Ministers of the Environment or CCME, 2001). Several parameters exceeded the reference area concentrations and/or applicable screening criteria and the test for statistical significance in one or more media. These substances were considered to be parameters of concern and were further assessed in the ecological risk assessment. The toxicity testing involving the bacteria and amphipods indicated a good survival rate in both the Ned's Pond/Pond #2/on-site marsh sediments and in the sediments from the reference areas.

In order to focus the ecological risk assessment, valued ecosystem components (VECs) were selected which were intended to be representative of the most sensitive receptors or classes of receptors which may be present and maximally exposed. The VECs selected for this risk assessment were benthic infauna; Brook trout (*Salvelinus fontinalis*); American Black Duck (*Anas rubripes*); and mink (*Mustela vison*). These organisms may be directly exposed to POCs in sediment and surface water, or for higher trophic levels (such as brook trout, black ducks and mink ingesting benthic infauna; or mink ingesting fish), may ingest organisms which may have accumulated the POCs.

The objective of the ERA was to ensure that no increased mortality (i.e. greater than 10% of the population) would result from exposure to the POCs in the sediment, surface water, and/or other aquatic organisms (i.e. ingestion of benthos) by the VECs identified.

The conclusions were as follows:

Benthic Infauna

- Based on the parameter concentrations identified in the sediment and surface water and the Microtox and amphipod toxicity testing results, no unacceptable risks are expected to benthic infauna in Ned's Pond and Pond #2.

- Based on the parameter concentrations identified in the sediment of the on-site marsh which exceeded the Interim Sediment Quality Guidelines (ISQG) and/or Probable Effects Level (PEL) (CCME, 2001), there may be localized adverse affects to benthic infauna in the on-site marsh, however, these impacts are not expected to represent a greater than 10% mortality to benthic infauna in the on-site marsh (assessment endpoint). In addition, November/December 2001 toxicity results would indicate low sediment toxicity to amphipods and bacteria.

Brook Trout

- Based on the parameter concentrations identified in the sediment, surface water and fish tissue, no unacceptable risks are expected to brook trout in Ned's Pond and Pond #2 in comparison to the reference areas.

Black Ducks

- Based on the parameter concentrations identified in the sediment and surface water, and based on toxicity testing and biota-to-sediment accumulation factor (BSAF) factors for sediment contaminants to benthic infauna, exposure to the surface water, sediment, or ingestion of benthic infauna in Ned's Pond, Pond #2 and/or the on-site marsh is not expected to pose unacceptable risks to black ducks.

Mink

- Based on the parameter concentrations identified in the sediment, surface water, and fish (fillets and carcasses), and based on toxicity testing and BSAF factors for sediment contaminants to benthic infauna, exposure to surface water, sediment, or ingestion of benthic infauna or fish from Ned's Pond, Pond #2 and/or the on-site marsh is not expected to pose unacceptable risks to mink.

No further action was recommended at this time to ensure the protection of ecological receptors from exposure to parameters in the sediment, surface water, benthic infauna, and/or fish from Ned's Pond, Pond #2 and/or the on-site marsh.

## SOMMAIRE À L'INTENTION DE LA DIRECTION

La Section des questions atmosphériques et toxiques de la Division de la protection de l'environnement d'Environnement Canada a élaboré la présente évaluation des risques écologiques pour l'étang Ned, l'étang 2 et un marais, qui se trouvent sur le site et à proximité de la station aérologique d'Environnement Canada, à Stephenville (Terre-Neuve-et-Labrador).

De 1943 à 1996, le site faisait partie de la base aérienne Ernest Harmon de l'armée de l'air américaine. Pendant cette période, la topographie du site a été modifiée, et plusieurs sites d'élimination ont été créés. Deux sites d'enfouissement de barils près des deux étangs ont été décrits dans les rapports antérieurs. Tous les produits chimiques éliminés sur les lieux de la station, y compris ceux potentiellement présents dans les sites d'enfouissement de barils, ont pu se lixivier dans le sol et/ou l'eau souterraine puis, par ruissellement ou alimentation souterraine, migrer vers l'étang Ned, l'étang 2 et/ou le marais. En raison de l'utilisation antérieure des terres (surtout militaire), des substances potentiellement préoccupantes (SPP) ont été étudiées : hydrocarbures pétroliers totaux (HPT), hydrocarbures aromatiques polycycliques (HAP), polychlorobiphényles (PCB), pesticides organochlorés et métaux.

Un programme d'étude sur le terrain a été réalisé par Environnement Canada en novembre et décembre 2001. Il consistait à prélever des sédiments, de l'eau de surface et des poissons de l'étang Ned, de l'étang 2 et/ou du marais ainsi que de trois zones de référence (étang Black Duck, étang témoin 2 sans nom et/ou marais de référence situé près de l'étang Black Duck). On a analysé tous les échantillons de sédiments, d'eau de surface, et de tissus et de carcasses de poissons pour y détecter des HAP, des PCB, des métaux, des pesticides organochlorés et/ou des HPT (sauf chez les poissons). On a examiné la chimie générale de l'eau de surface et analysé les sédiments en vue de mesurer leur toxicité pour les bactéries (*Vibrio fischeri*) et les amphipodes (*Hyalella azteca*).

Les résultats d'analyse des échantillons prélevés dans l'étang Ned, l'étang 2 et le marais (le cas échéant) ont été comparés aux résultats d'analyse des échantillons prélevés dans les zones de référence ainsi qu'aux critères de dépistage applicables (Conseil canadien des ministres de l'environnement, ou CCME, 2001), le cas échéant. Dans au moins un milieu, la concentration de plusieurs SPP dépassait les concentrations et/ou les critères de dépistage ainsi que la valeur du test de signification statistique. Les SPP ont donc été considérées comme paramètres, puis évaluées de manière plus approfondie dans l'évaluation des risques écologiques. Des tests de toxicité visant les bactéries et les amphipodes ont indiqué un bon taux de survie tant dans les sédiments de l'étang Ned, de l'étang 2 et du marais que dans les sédiments des zones de référence.

Pour mieux cibler l'évaluation des risques écologiques, on a choisi des composantes valorisées de l'écosystème (CVE) représentatives des récepteurs ou des catégories de récepteurs les plus vulnérables qui peuvent être présents et subir une exposition maximale. Les CVE choisies pour la présente évaluation étaient l'endofaune benthique, l'omble de fontaine (*Salvelinus fontinalis*), le canard noir (*Anas rubripes*) et le vison d'Amérique (*Mustela vison*). Elles peuvent être directement exposées aux SPP dans les sédiments et l'eau de surface; aux niveaux trophiques plus élevés, les prédateurs sont indirectement exposés, car ils peuvent manger des organismes ayant accumulé des SPP (l'omble de fontaine, le canard noir et le vison d'Amérique mangent des organismes de l'endofaune benthique; par ailleurs, le vison d'Amérique mange aussi des poissons).

L'évaluation des risques écologiques a pour objectif de s'assurer que les CVE exposées aux SPP dans les sédiments, l'eau de surface et/ou par l'intermédiaire d'autres organismes aquatiques (par ingestion de benthos) ne présenteront pas une mortalité accrue (plus de 10 % de la population).

Les conclusions étaient les suivantes :

Endofaune benthique

- D'après les concentrations des SPP dans les sédiments et l'eau de surface, et d'après les résultats des tests de toxicité Microtox et des tests de toxicité pour les amphipodes, il ne devrait pas y avoir de risques inacceptables pour l'endofaune benthique de l'étang Ned et de l'étang 2.

- D'après les concentrations des SPP dans les sédiments du marais, qui dépassaient les Recommandations provisoires pour la qualité des sédiments (RPQS) et/ou la concentration avec effet probable (CCME, 2001), il pourrait y avoir des effets adverses localisés sur l'endofaune benthique du marais. Toutefois, ces effets ne devraient pas entraîner un taux de mortalité supérieur à 10 % (paramètre de l'évaluation). De plus, les résultats des tests de toxicité de novembre et décembre 2001 indiquent une faible toxicité des sédiments pour les amphipodes et les bactéries.

Omble de fontaine

- D'après les concentrations des SPP dans les sédiments, l'eau de surface et les tissus des poissons, il ne devrait pas y avoir plus de risques inacceptables pour l'omble de fontaine dans l'étang Ned et l'étang 2 que dans les zones de référence.

Canard noir

- D'après les concentrations des SPP dans les sédiments et l'eau de surface, et d'après les résultats des tests de toxicité et le facteur BSAF (facteur d'accumulation biote-sédiment), qui mesure le transfert des contaminants des sédiments vers l'endofaune benthique, l'exposition à l'eau de surface et aux sédiments ainsi que l'ingestion d'organismes de l'endofaune benthique de l'étang Ned, de l'étang 2 et/ou du marais ne devraient pas poser de risques inacceptables pour le canard noir.

Vison d'Amérique

- D'après les concentrations des SPP dans les sédiments, l'eau de surface et les poissons (filets et carcasses), et d'après les résultats des tests de toxicité et le facteur BSAF, qui mesure le transfert des contaminants des sédiments vers l'endofaune benthique, l'exposition à l'eau de surface et aux sédiments ainsi que l'ingestion d'organismes de l'endofaune benthique de l'étang Ned, de l'étang 2 et/ou du marais ne devraient pas poser de risques inacceptables pour le vison d'Amérique.

Pour le moment, on ne recommande aucune autre mesure pour protéger les récepteurs écologiques de l'exposition aux SPP se trouvant dans les sédiments, l'eau de surface, l'endofaune benthique et/ou les poissons de l'étang Ned, de l'étang 2 et/ou du marais.

## ACKNOWLEDGMENTS

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## GLOSSARY OF TERMS

| | |
|---|---|
| ADI | Average daily intake from a multitude of sources |
| AEB | Environment Canada Atmospheric Environment Branch |
| Aquatic receptor/aquatic ecological receptor | Any non-human (i.e., ecological component), either flora or fauna, which is or may be present in the study area, whose habitat is in the water (freshwater) |
| AST | Above-ground petroleum storage tank |
| ASTM | American Society for Testing Materials, responsible for many of the standard methods used in industry. |
| Benthic Infauna | Any bottom (benthic) dwelling organism living in the sediment which lacks a backbone or spine, such as larvae, aquatic worms, crustaceans, and/or molluscs |
| Bioaccumulation | An increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Compounds accumulate in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted. |
| BSAF | Biota-to-sediment accumulation factor - ratio of the concentration of a chemical in an organism to the concentration of the chemical in sediment. |
| Biota | The flora and/or fauna of an area |
| BTEX | Benzene, toluene, ethylbenzene and xylenes. Common components of petroleum hydrocarbons used as indicator parameters when analysing soil and water for hydrocarbon content. |
| Carcinogen/carcinogenic | A chemical or substance capable of producing cancer in living organisms/tending to produce or incite cancer in living organisms. |
| CCME | Canadian Council of Ministers of the Environment. The major inter-governmental forum in Canada for discussion and joint action on environmental issues of national and international concern. It is made up of environment ministers from the federal, provincial and territorial governments. Established the *Canadian Environmental Quality Guidelines* for soil, surface water, sediment and biota tissue. |
| Cd | Predicted chemical concentration in sediment pore water |
| Cs | Predicted chemical concentration in sediment |
| Chronic toxicity | The occurrence of symptoms, diseases or other adverse health effects that develop and persist over time, after exposure to a single dose or multiple doses of a chemical delivered over a relatively long period of time. |
| Degradation | The physical, chemical, or biological breakdown of a complex compound into simpler compounds and by-products. |
| Dermal exposure | Exposure to a chemical by an organism or receptor through skin absorption. |
| Ecological receptor | A non-human living organism that may be exposed to a chemical or physical hazard. |
| ECB | Environmental Conservation Branch (Environment Canada) |
| ERA | Ecological Risk Assessment |
| ESA | Environmental Site Assessment |
| Exposure pathway | The course a chemical or physical agent takes from a source to an exposed population or organisms; it describes the unique mechanisms by which an individual or population is exposed to chemicals or physical agents at or originating from a site |
| Exposure scenario | A set of conditions or assumptions about hazard sources, exposure pathways, levels of chemicals, and potential receptors that aids in the evaluation and quantification of exposure in a given situation. |
| FAL | CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)*. Surface water and sediment quality guidelines set at such values as to protect all forms of aquatic life and all aspects of the aquatic life cycles. The goal of the guidelines is to protect all life stages during an indefinite exposure to water and/or sediment. |
| Foc | Fraction of organic carbon |
| GPS | Geographic Positioning System |
| Groundwater | The portion of subsurface water that is below the water table, in the zone of saturation. |

## GLOSSARY OF TERMS

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| Hazard | The inherent adverse effect that a chemical or other object poses. It is that which has the potential for creating adverse consequences. |
| Impacted | Any media which contains the one or more of the parameters of concern (POCs) |
| ISQG | CCME Canadian Sediment Quality Guidelines for the Protection of Aquatic Life *Interim Sediment Quality Guidelines.* |
| Koc | Partition coefficient between pore water and sediment solids (L/kg) |
| Kp | Partition coefficient between pore water and sediment solids, normalized with respect to organic content of sediment (L/kg) |
| Modified TPH | TPH (total petroleum hydrocarbons) minus toluene, ethylbenzene and xylenes |
| Mbg | metres below grade |
| mg/kg | milligrams per kilogram, a unit of concentration, may also be expressed as parts per million (ppm) |
| MOE | Ontario Ministry of the Environment |
| MW | monitor well |
| NDE | Newfoundland Department of Environment |
| PAH | Polycyclic aromatic hydrocarbon – suite of compounds comprised of two or more aromatic rings. PAHs are found in many petroleum mixtures and they are predominantly introduced to the environment through natural and anthropogenic combustion sources |
| Parameter | Generic term to define the chemicals, metals and/or biologicals which are present in the various media |
| PAS | Philip Analytical Services |
| Pathway | Any specific route by which a potential receptors or individual may be exposed to an environmental hazard, such as the release of a chemical material |
| PCB | Poly-Chlorinated Biphenyl |
| PEL | Probable effects level (from CCME, 2001) – the concentration at which adverse effects are likely to occur to ecological receptors |
| Petroleum Hydrocarbons | Organic compounds that contains only carbon and hydrogen; derived mostly from crude petroleum and also from coal tar and plant sources. |
| Ppb | parts per billion; a unit of concentration (micrograms/litre, µg/L) |
| Ppm | parts per million, a unit of concentration (milligrams/kilogram, mg/kg) |
| Potable water | Water of sufficient quality to use for drinking purposes. |
| POC | Parameter of Concern |
| QA/QC | Quality assurance/quality control – quality standards used to ensure quality is maintained |
| Remediation | The removal or abatement of contamination present in soil and/or groundwater. |
| RDI | Residual Daily Intake - the remaining allowable intake between the tolerable daily intake and the average daily intake |
| Risk | The probability or likelihood of an adverse consequence from a hazardous situation or hazard, or the potential for the realization of undesirable adverse consequences from impending events. |
| Risk Assessment | A study of receptors, hazards and exposure pathways to determine the potential risks to human and ecological receptors. |
| RPC | Research and Productivity Laboratory |
| Sediment | Fragments of organic or inorganic material that are transported by, suspended in, or deposited by surface water. |
| Sediment pore water | Water which is located within the sediment pore space |
| Stratigraphy | The classification of subsurface soil and bedrock conditions on the basis of characteristics, properties, or attributes. |
| Subsurface soil | Soil which is greater than one metre below ground surface |
| Surface soil | Soil which is less than one metre below ground surface |
| Terrestrial receptor | Any non-human (i.e., ecological component), either flora or fauna, which is or may be present in the study area, whose habitat is on land |
| TDI | Tolerable daily intake. The maximum amount of a chemical that an organism can absorb without experiencing chronic health effects. |

## GLOSSARY OF TERMS

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| Tier I criteria | Generic criteria developed to be protective of large segments of the population, in the absence of site-specific criteria. |
| Topography | The configuration of a land surface, including its variations in altitude and slope or by irregularities of the land. |
| Toxicity | The harmful effects produced by a chemical substance. It is the quality or degree of being poisonous or harmful to human or ecological receptors. |
| TPH | Total Petroleum Hydrocarbons. An analytical measurement indicating the concentration of hydrocarbons in a soil or groundwater sample. |
| UAS | Upper Air Station |
| UCL | Upper confidence limit - it is the upper bound of a confidence limit used to assign probabilities to the size of sampling error. Confidence limits are used to describe a range within which a true value lies with a stated probability. |
| Uncertainty | The lack of confidence in the estimate of a variable's magnitude or probability of occurrence. |
| USAF | United States Air Force |
| US EPA | United States Environmental Protection Agency |
| UST | Underground petroleum storage tank |
| VECs | Valued Environmental Components - resources or environmental features that are important to human populations based on economic or social values, have intrinsic ecological significance, and/or serve as a baseline from which the impacts of development can be evaluated (CCME, 1996; 1997) |
| VOCs | Volatile organic compounds |

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# 1. INTRODUCTION

Environment Canada, Environmental Protection Branch, Air and Toxics Issues Section, has prepared the following aquatic ecological risk assessment for Ned's Pond, Pond #2, and a marshy area (referred to in this report as the on-site marsh) on and adjacent to the Environment Canada Upper Air Station (UAS) property, Stephenville, Newfoundland (see Drawings in Appendix A for locations and sample stations).

From 1943 to 1996 the site was part of the Ernest Harmon United States Air Force (USAF) air base. During this time, the site topography was modified and several waste disposal areas were created. Two known buried waste barrel disposal areas were identified on the property near the two ponds (ADI, 1997). Any chemicals disposed of on the property, including those potentially present in the barrel disposal areas, may have leached into the soil and/or groundwater and migrated either via surface runoff or groundwater discharge to Ned's Pond, Pond #2, and/or the on-site marsh. Due to the nature of the previous land use (primarily for military purposes), the potential parameters of concern (POCs) were determined to be petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), organochlorine pesticides, and metals.

The specific objective of this risk assessment is to provide a qualitative evaluation of the potential risks to ecological populations and communities, due to the potential presence of the above-mentioned POCs in the sediment and surface water of Ned's Pond, Pond #2, and the on-site marsh.

This screening level ecological risk assessment has been conducted in accordance with the Canadian Council of Ministers of the Environment (CCME) 1996a and 1997 Level I ecological risk assessment guidance.

Previous site investigations have been conducted by ADI Nolan Davis (ADI) (1997-2000), Environment Canada (2001), and Cantox Environmental (2001) and are summarized below in Section 2.2.

## 1.1 Ecological Risk Assessment Methodology

Ecological risk assessment (ERA) is the formalized process that has been developed for assessing and quantifying risks to ecological receptors from exposure to one or more stressors. It is a process for organizing and analyzing information, assumptions, and uncertainties to evaluate the likelihood of adverse ecological effects. It provides risk managers with an approach for considering available scientific information in order to select an appropriate course of action.

The Canadian Council of Ministers of the Environment (CCME) has developed a *Framework for Ecological Risk Assessment, General Guidance* (1996) and *Technical Appendices* (1997) which are intended to outline the required information and proposed format by which to conduct an ERA.

The ERA process as defined by CCME, is iterative and tiered. The three tiers of an ERA as defined by CCME (1996) are:

- **Screening Assessment** - characterized by simple, qualitative and/or comparative methods, relying primarily on literature
- **Preliminary Quantitative ERA** - utilizes standard environmental methods and models, with an increased emphasis on data collection and focus on priority issues as determined during the Screening Assessment
- **Detailed Quantitative ERA** - relies on site-specific data and predictive modeling to supply quantitative information, particularly on complex ecosystem responses.

Each level in this tiered approach to an ERA has the same structure and builds upon the data, information, knowledge and decisions from the preceding level. Thus, each level is progressively more complex. Initial tiers in an ERA are typically based on conservative assumptions such as maximum exposure or ecological sensitivity. If an initial tier cannot sufficiently define the risk in order to make appropriate risk management decisions, it may be necessary to undertake a subsequent tier to acquire the data required to adequately characterize the potential risk. Higher tiers provide more ecologically realistic assessments by making less conservative assumptions about exposure and effects.

Each tier contains the following four components:

- Receptor Identification
- Exposure Assessment
- Hazard Assessment
- Risk Characterization

The receptor identification should identify the species, communities, habitats and valued environmental components (VECs) that are most likely to be affected by the POCs at the site. The exposure assessment should consider the pathways by which VECs may be exposed to the potential POCs and whether those pathways apply to the specific site conditions. It may also be relevant to consider the size of the impacted area in comparison with the habitat area normally occupied by VEC organisms. The hazard assessment should identify the parameters present and consider whether they are present at concentrations that could potentially cause adverse effects on exposed biota. Finally, the extent and nature of the risk and the level of uncertainty associated with the risk, are derived by integrating the available information. This integration may be achieved using qualitative or quantitative methods. Professional judgment may be relied upon when using qualitative methods such as ranking systems (i.e. high, moderate, low) that determine the potential level of risk.

Risk can be defined as the product of the level of hazard, and the degree of exposure of a given receptor. Risk does not exist unless the hazard exists with the receptor and there are active pathways that enable the receptor to be exposed to the hazard.

Upon completion of a Screening Assessment, the adequacy of the ERA with respect to the site-specific objectives for the site needs to be evaluated. If the perceived risk is low enough to be considered negligible, the ERA will end at the Screening Assessment. If significant risk is believed to be present, or if there is significant uncertainty such that risks may be potentially significant, further assessment (i.e. Preliminary Quantitative ERA) may be required.

## 2. SITE CHARACTERIZATION

The following sections present a brief description of the site, site history, environmental setting and the nature and distribution of the identified POCs. The summary is based on previous reports prepared by ADI (1997-2001) and Cantox Environmental (2001) and is intended to provide sufficient detail to understand the assumptions and basis for the risk assessment. Additional details can be found in the ADI and Cantox reports listed in Section 6.0, References, at the end of this document. In addition, Figures of the Stephenville UAS site are presented in Appendix A.

### 2.1 Site Description

The subject property, owned by Environment Canada, is approximately 55.34 hectares in area and is located on the north side of Maryland Drive in Stephenville, Newfoundland (see Figures in Appendix A for site and building locations). The property currently contains six structures; four of which comprise the former Environment Canada Upper Air Station (UAS) on the west side of the property (Operations Building, Hydrogen Building, and two storage sheds), while the other two consist of former munitions

storage bunkers on the east side of the property (see Figure 7 in Appendix A for approximate Bunker locations). The developed portion of the site is approximately 30,000 $m^2$ and is a relatively flat gravel and grass-covered area. The topography surrounding this flat area is steeply sloping toward the west, north and eastern portions of the site (ADI, 1997).

The soil stratigraphy of the developed portion of the site was identified as containing a surface layer of a fill material of local origin, from surface to a depth of between 1.5 and 10.2 metres below grade (mbg). This fill material was of variable composition, brown, locally grey sand and gravel, gravely or silty sand, sand and silt to sandy silt with cobbles and boulders. The till layer, underlying the fill, was comprised of gravely sand to sand and gravel, with trace of silt and occasional cobbles and boulders. Although no bedrock was encountered during any of the field programs, it is believed to be subhorizontal carboniferous bedrock (Cantox, 2001).

Groundwater was not encountered in the majority of the test pits and boreholes. Where encountered, the average depth to groundwater ranged between 0.6 and 11 mbg (ADI, 1998).

The property is bounded to the north by Provincial Crown Lands, to the east by Provincial properties, to the south by Minnesota Drive and the Town of Stephenville, and to the west by the Newfoundland and Labrador Housing Corporation property. The closest residence is along Maryland Drive to the south of the site (Cantox, 2001).

The property, which is located within the Town of Stephenville water supply catchment area, contains a portion of Ned's Pond and all of a smaller feeder pond known as Pond #1 in ADI reports and Pond #2 in Environment Canada reports, which are part of the backup water supply for the Town. In addition to these two ponds, there is also a marsh north of the UAS buildings and south of Ned's Pond, identified in previous reports as Pond #2 (ADI, 1997-2000) and in this report as the 'on-site marsh'. The names of these 'ponds' were changed by Environment Canada field personnel during the November/December 2001 field program, and for consistency, the names used by Environment Canada are used in this report.

Sediment composition in the two ponds and on-site marsh was identified as silty sand and clay with traces of gravel (Cantox, 2001).

The southern part of the property is bisected by numerous gravel-surfaced roads, many of which have been blockaded. Access to the site is via Maryland Drive. The site is serviced by municipal water and sewer. The remainder of the property is heavily wooded and areas that were extensively altered in the past are now overgrown by alders (Cantox, 2001) (see Figure 5 in Appendix A for approximate extent of altered area).

### 2.1.1 Climate

Canadian climate normals for Stephenville, NF, are summarized here from the Environment Canada 30 year Canadian Climate Normals database for the Stephenville Airport (Environment Canada, 2002a). The average daily maximum temperature ranges from -3.1°C in February to 30°C in July and August. The average daily minimum temperature ranges from -11.3°C in February to 12.3°C in August. Rainfall amounts range from 22 millimetres (mm) in February to 121.5 mm in August, with an annual average rainfall of 840.5 mm. Snowfall amounts range from 0 in the summer months to 113.8 centimetres (cm) in January, with an annual average snowfall of 411.8 cm. Wind speeds range from 13 kilometres/hour (km/hr) in July to 23 km/hr in January, with an average of 18 km/hr.

### 2.1.2 Site Background

The property was part of the Ernest Harmon United States Air Force (USAF) air base from 1943 to 1966. The southern portions of the property exhibit evidence of an extensive and varied land use during the USAF and subsequent occupations, however, northern parts of the property have had less usage (Cantox, 2001).

Based on aerial photographs, between 1949 and 1966 during the site use as the USAF air base, the northern portion of the site between Ned's Pond and Pond #2 changed substantially, with the infilling of the southern portion of Pond #2 and the diversion (natural or anthropogenic) of the water to a shallow arm of Ned's Pond. According to ADI (1998), this infilled area is believed to have been the site of the base domestic dump (see Figure 5 in Appendix A, for approximate location).

Following the closure of the USAF base, the on-site buildings were used as a ski lodge from 1966-1970 and for a television station. The ski lodge was believed to have been demolished in the late 1980s. The Environment Canada Atmospheric Environment Branch (AEB) Upper Air Station (UAS) was built in 1969 and used until 1995, at which time the AEB (now Meteorological Services Branch or MSB) left the premises. Nav Canada subsequently moved its airport technical services operations to the site and utilized the site until December, 1996. The UAS buildings have been predominantly vacant since December, 1996 (Cantox, 2001).

### 2.1.3 Potential Sources of Impacts

There is evidence of many years of illegal dumping along many gravel roadways on the southern portions of the property, including automobiles, furniture, appliances and construction debris. Historical dumping of domestic use around the former munitions bunkers has also been reported (Cantox, 2001).

The toe of the northern slope of the plateau contained a variety of construction debris and approximately 2500 empty, predominantly flattened, 250 litre steel barrels (Barrel Dump #1). The dumpsite area covered approximately 2000 $m^2$ and was 100 m upgradient of Ned's Pond. Based on historical information, it is believed that the buried barrels contained roofing pitch and/or asphalt material. Fill material, likely of local origin, was used to cover much of the debris. A second barrel dump (Barrel Dump #2) was located west of the UAS buildings, which was estimated to contain up to 500 205 L barrels. Barrels were also found in Ned's Pond and in the on-site marsh.

In 1997, ADI supervised the removal and disposal (at the Cornerbrook landfill) of approximately 3000 205L barrels from Barrel Dumps #1, #2 and along the shoreline of Ned's Pond. Banks and slopes were stabilized with local fill material, however due to structural concerns and slope stability, not all barrels were removed from the areas, therefore some barrels currently remain on-site. During the most recent sediment and surface water collection program in November-December, 2001 by Environment Canada, exposed and rusted barrels were identified along the slope of the plateau (Julien, 2002, personal communication).

An area south of the UAS property was reported to have been used as a contractor's camp during the construction of the USAF base (location not identified in previous reports). A former domestic waste dump used during the operational lifetime of the base lies approximately 500 m northeast of the UAS property on Igloo Road (location not identified in previous reports). There was one account from an interviewee that a former USAF base dry-cleaning facility was demolished and disposed of at this location in 1966, along with associated dry-cleaning chemicals and equipment (total volume of dry-cleaning solvents disposed not identified) (ADI, 1998). When this disposal area became full in 1965-66, a location in the southeast quadrant of the UAS property was used as a dumpsite (south of Barrel Dump #2) (see Figure 4 in Appendix A for approximate dumpsite location).

A former US Air Force UAS existed south of Environment Canada's UAS. It is believed that there may be potential environmental impacts from this area on the current UAS due to past activities at the US UAS, such as the presence of abandoned above-ground storage tanks (ASTs), underground storage tanks (USTs), and/or improper septic tank decommissioning.

No USTs have been reported to have been located on the Environment Canada UAS property. The former ski lodge did have ASTs (furnace oil), which are believed to have been removed during the lodge demolition. A former 18,000 L tanker truck was buried north of the ski lodge for use as a septic tank.

## 2.2 Previous Investigations

ADI has conducted a number of environmental site assessments at the Upper Air Station property, from 1997 until 2001. These investigations included a Phase I and II Environmental Site Assessment (ESA), remediation work in the barrel dump areas, supplementary site investigation and sampling programs. In addition, Environment Canada collected five sediment samples from the on-site marsh on May 24, 2001, and submitted them to the Environment Canada Environmental Conservation (ECB) Lab in Moncton, New Brunswick for toxicity testing.

Soil, groundwater, sediment and/or surface water samples were collected during these previous investigations, and analysed for a variety of parameters (benzene, toluene, ethylbenzene, xylenes and total petroleum hydrocarbons [BTEX/TPH]; metals; polycyclic aromatic hydrocarbons [PAHs], organochlorine pesticides, polychlorinated biphenyls [PCBs]; and volatile organic compounds [VOCs]). See Table C.1 in Appendix C for a list of typical compounds in each of the analytical suites.

In general, the analytical data for soil, groundwater, sediment and surface water indicated limited environmental impacts as a result of activities on the UAS property. The majority of the parameters analysed were either not detected or were below applicable generic criteria (ADI, 2001). Several sediment and surface water samples taken from Ned's Pond or the on-site marsh, however, exceeded applicable criteria for PAHs, metals and one for PCBs (sediment only).

Environment Canada (May, 2001) conducted two different types of bioassay studies (amphipod and bacterium) on sediment samples from the on-site marsh north of the Barrel Dump #1. Toxicity was reported in amphipod (*Hyalella azteca*) tests from two sediment samples (one sample with growth and survival effects; a second with growth effects compared to the laboratory control group). Three samples exhibited toxicity to the bacterium *Vibrio fischeri*, when compared to applicable interpretation guidelines. There was no distinct correlation, however, with the toxicity results and chemical concentrations in the sediment. In addition, the samples were submitted at an elevated temperature, which may have compromised the samples, thus, there were quality control (QC) issues associated with these samples submitted.

Cantox Environmental (2001) summarized the existing data on the site in order to determine any additional data required to complete a human health and/or ecological risk assessment. The report identified inconsistencies in the data between 1999, 2000 and 2001, primarily with respect to TPH, PAHs, and PCBs. It appeared that a rigorous QA/QC process was not undertaken by ADI, with no data quality objectives established, and unclear information pertaining to homogenization of samples in the field prior to splitting them for analytical and/or biological testing. The report also indicated that there was inadequate sampling of background/reference areas. Concern was also expressed about the results of the bioassay studies, including the elevated temperature of the samples received by Environment Canada (greater than 4°C).

Cantox (2001) recommended the following:

- Establish data quality objectives, such that analytical detection limits are lower than the applicable environmental quality guidelines;
- Conduct additional surface water sampling in Ned's Pond for metals, PAHs, TPH, PCBs, pesticides and general water chemistry parameters;
- Identify an appropriate reference pond and sample for the same parameters;
- Analyze fish tissues (fillet samples recommended) for PCBs, and bioaccumulative metals such as mercury;
- Ensure proper QC by submitting either QA (blind) samples to the same lab or submit samples to two different labs; and
- Examine the anomalous reading for perylene in sediment by running samples through a GC/MS in scan mode to determine if perylene is present or if the peak is another substance resembling perylene.

For the purpose of addressing these recommendations, Environment Canada (Air and Toxics Issues Section, Environmental Protection Branch), undertook an extensive sediment, surface water and fish sampling program in Ned's Pond, Pond #2, the on-site marsh, two reference ponds (Black Duck Pond and Control Pond 2) and one reference marsh in November and December, 2001.

### 2.3 Environment Canada Sampling Program (November-December, 2001)

Ned's Pond (N 48° 33.8 x W 0.58° 34.2) , Pond #2 (N 48° 33.8 x W 0.58° 33.7), and two reference sites; Black Duck Pond, off Route 461 (N 48° 5.5 x W 0.58° 23.0 and an unnamed pond [Control Pond 2] off the Trans-Canada Highway, (east of George's Lake located at N 48° 44.3 x W 0.58° 07.5) were selected for the collection of sediment, water, and fish for analysis of PCBs, organochlorine pesticides, metals including mercury, PAHs, petroleum hydrocarbons, and/or sediment toxicity. In addition, the on-site marsh and a reference marsh (located south of Black Duck Pond at N 48° 35.2 x W 58° 23.2) were selected for the collection of sediment samples for analyses of metals, PAHs, petroleum hydrocarbons, organochlorine pesticides and sediment toxicity. Due to the low to nonexistent surface water present in these marshes, no surface water samples were collected. The sample locations are presented in Figures 1 to 10 in Appendix A.

On Monday, November 19, 2001, gill nets were deployed in each of the ponds. Nets were of a 1 inch mesh size and 100 feet in length at each pond, except Ned's Pond where a multi-panel net was set with 1 inch, 1.5 inch, and 2 inch mesh. Nets were monitored daily, and fish (Brook trout [*Salvelinus fontinalis*]) were removed and held in Ziploc bags and frozen at the end of the day. The fish were filleted and carcass and fillet were measured and weighed. In Ned's Pond, 7 fish were collected, ranging in length from 15.5 to 26.5 cm and weight from 50.2 to 189 g; in Pond #2, 9 fish were collected, ranging in length from 11.8 to 14.5 cm and weight from 22.8 to 32.9 g; in Black Duck Pond, 6 fish were collected, ranging in length from 13.5 to 15 cm and weight from 26.8 to 33.6 g; and in Control Pond 2, 15 fish were collected, ranging in length from 13 to 17.5 cm and weight from 27.3 to 42.8 g. The largest fish caught was in Ned's Pond and the smallest fish was caught in Pond #2. The mean fish lengths and weights are comparable across all four ponds. In addition, based on discussions with field personnel responsible for the fish collection, all fish collected appeared healthy with no visible lesions or other deformities (Julien, 2002, personal communication). Each fillet and each carcass was submitted separately for laboratory analyses.

On Tuesday, November 20, 2001, sediments were collected using an Ekman Dredge from all ponds (five samples) and the on-site marsh (two samples). Contents of the dredge were released into a pre-cleaned (washed with lab grade soap, rinsed first with water, then distilled water, acetone, and hexane, respectively) stainless steel bowl, homogenized with a pre-cleaned stainless steel spoon, and then transferred to individual containers for the analyses. Water was collected on Wednesday, November 21 from five locations at Ned's Pond, Pond #2, Control Pond 2, and the morning of November 22 at Black Duck Pond using either a Teflon Niskin bottle or a polycarbonate Van Duran bottle at

approximately 1 metre above the bottom. Water was drained into individual sample bottles at the sample site. The five water samples from each of the ponds were collected near the sediment sample locations.

On December 13, Environment Canada personnel collected two sediment samples from the on-site marsh and two from a reference marsh located south of Black Duck Pond. Samples were collected using a shovel, and the volume collected consisted of a one litre plastic bottle and three one litre mason jars.

Sample locations were recorded with a hand-held geographic positioning system (GPS) for each sample collected. During the November fish collection program, nets were moved around the ponds as required to collect adequate fish numbers for analysis (Collection Permit #NF-0552-01 issued by the Department of Fisheries and Oceans, St. John's, Newfoundland).

All samples were packed in coolers and shipped by air to Fredericton, New Brunswick, to the Research and Productivity Laboratory (RPC) for the chemical analyses and to the Environment Canada ECB Laboratory in Moncton for toxicity testing.

Remaining sediment samples from each of the ponds were homogenized by pond at ECB (i.e. the remaining sediment from five samples collected at Ned's Pond were combined and homogenized, etc.). The sample was divided into three subsamples which were submitted to RPC, Philip Analytical Services (PAS), Halifax, Nova Scotia, and the ECB lab for TPH, PAH, metals and organochlorine pesticide analysis (for quality assurance/quality control [QA/QC] purposes). In addition, the sediment samples collected in the on-site marsh and reference marsh on December 13 were submitted to RPC and PAS for the same analyses for QA/QC purposes.

In summation, at each of the ponds, five sediment and surface water samples were collected, and two sediment samples were collected from the on-site marsh and the reference marsh. All sediment samples were submitted for analyses for the following parameters: 1) metals and mercury; 2) petroleum hydrocarbons; 3) organochlorine pesticides; 4) PCBs; 5) PAHs; 6) grain size; and 7) toxicity to bacteria (*Vibrio fischeri*) and amphipods (*Hyalella azteca*). All water samples were submitted for: 1) metals and mercury; 2) petroleum hydrocarbons; 3) organochlorine pesticides; 4) PCBs; 5) PAHs; and 6) general chemistry. Fish fillets and fish carcasses were submitted for the following parameters: 1) metals and mercury; 2) organochlorine pesticides; 3) PCBs; and 4) PAHs.

### 2.3.1 Results

The analytical results for the November/December 2001 sediment, surface water, fish and toxicity testing are summarized below and in the Analytical Summary Tables in Appendix B. The sample locations are presented in the Figures in Appendix A. Previous analytical results from other reports (i.e. ADI, 1997-2000) are presented in the individual reports and have not been reproduced here or in the summary tables in Appendix B.

All results (including the QA samples) were compared to applicable generic screening criteria, including the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (freshwater) (2001), CCME *Canadian Sediment Quality Guidelines for the Protection of Aquatic Life* (freshwater) (2001), the CCME *Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota*, and/or the Ontario Ministry of the Environment (MOE) *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario* (1993). In addition, the results from Ned's Pond, Pond #2 and the on-site marsh have been compared to the results from Black Duck Pond, Control Pond 2 and the reference marsh (background or reference areas). The results have been summarized in the following sections. The analytical detection limits for each of the analyses for the applicable laboratories is presented in the tables in Appendix B.

### 2.3.1.1 Sediment

TPH:

The sediment TPH analytical results are presented in Table B.3 in Appendix B and are summarized in this section.

Low fuel/lube oil range petroleum hydrocarbons were identified in the on-site marsh, Ned's Pond, Pond 2, Black Duck Pond, Control Pond 2 and the reference marsh. Table 2.1 presents the maximum TPH concentration identified in Ned's Pond and Pond 2, the maximum identified in all on-site sediment samples (Ned's Pond, Pond 2 and the on-site marsh), the maximum identified in all reference areas (Black Duck Pond, Control Pond 2, and the reference marsh), and the maximum identified concentration of all samples collected.

**Table 2.1 Summary of Maximum Sediment TPH Results**

| Maximum Concentration Calculation | Units | Benzene | Toluene | Ethyl benzene | Xylenes | C6-C10 | C11-C20 | C21-C32 | Total TPH | Location |
|---|---|---|---|---|---|---|---|---|---|---|
| Maximum Concentration (Ned's Pond and Pond 2) | mg/kg | nd | 0.06 | nd | 0.12 | 3.8 | 180 | 1240 | 1296 | Ned's Pond |
| Maximum Concentration (Ned's Pond, Pond 2 and On-site Marsh) | mg/kg | nd | 0.06 | nd | 0.12 | 18 | 180 | 1240 | 1296 | Ned's Pond (except C6-C10 from the on-site marsh) |
| Maximum Concentration (Black Duck Pond, Control Pond 2 and Reference Marsh) | mg/kg | nd | nd | nd | nd | nd | 26 | 1110 | 1152 | Control Pond 2 |
| Maximum Concentration (all samples in all areas) | mg/kg | nd | 0.06 | nd | 0.12 | 18 | 180 | 1240 | 1296 | Ned's Pond and C6-C10 from the on-site marsh |

There are no federal sediment quality criteria for toluene, xylenes or TPH. The Ontario Ministry of the Environment (MOE) (1993), however, has a criteria of 1500 mg/kg oil and grease in sediment which is analogous to a lowest effect level for benthic invertebrates. As presented in Table 2.1, the highest identified sediment TPH concentration was less than the MOE guideline, thus, no adverse effects are expected to aquatic receptors, particularly benthic invertebrates, due to the current TPH concentrations in sediment of any of the samples collected. In addition, TPH (non PAH parameters) tend to have low bioaccumulation factors, indicating low potential for bioaccumulation in higher trophic organisms.

PAHs:

The maximum sediment PAH analytical results are presented in Table B.5 in Appendix B and are summarized in Table 2.2. These results are presented in a format similar to Table 2.1, with the maximum concentration identified in Ned's Pond and Pond 2, the maximum in all on-site sediment samples, the maximum in all off-site reference areas, and the maximum concentration of all samples collected. The highlighted values indicate the location of the highest sediment PAH concentration identified.

**Table 2.2: Summary of Maximum Sediment PAH Results**

| Parameter | Maximum Concentration in Ned's Pond and Pond 2 mg/kg | Maximum Concentration in Ned's Pond, Pond 2 and On-site Marsh mg/kg | Maximum Concentration in Black Duck Pond, Control Pond 2 and Reference Marsh mg/kg | Maximum Concentration (all samples in all areas) mg/kg |
|---|---|---|---|---|
| Naphthalene | 0.09 | 0.09 | 0.11 | 0.11 |
| Perylene | 5.00 | 5.00 | 10.00 | 10.00 |
| 2-Methylnaphthalene | nd | nd | nd | nd |
| 1-Methylnaphthalene | nd | nd | nd | nd |
| Acenaphthylene | nd | nd | 0.01 | 0.01 |
| Acenaphthene | 0.01 | 0.10 | nd | 0.10 |
| Fluorene | 0.02 | 0.14 | nd | 0.14 |
| Phenanthrene | 0.11 | 0.87 | 0.04 | 0.87 |
| Anthracene | 0.04 | 0.23 | 0.01 | 0.23 |
| Fluoranthene | 0.17 | 0.91 | 0.07 | 0.91 |
| Pyrene | 0.12 | 0.69 | 0.05 | 0.69 |
| Benzo(a)anthracene | 0.06 | 0.28 | 0.02 | 0.28 |
| Chrysene | 0.07 | 0.44 | 0.04 | 0.44 |
| Benzo(b)fluoranthene | 0.60 | 0.60 | 0.07 | 0.60 |
| Benzo(k)fluoranthene | 0.60 | 0.60 | 0.07 | 0.60 |
| Benzo(a)pyrene | 0.07 | 0.26 | 0.04 | 0.26 |
| Indeno(1,2,3-cd)pyrene | 0.06 | 0.20 | 0.17 | 0.20 |
| Dibenz(a,h)anthracene | 0.06 | 0.06 | 0.02 | 0.06 |
| Benzo(ghi)perylene | 0.06 | 0.13 | 0.13 | 0.13 |

As presented in Table 2.2, the highest concentrations of benzo(b)fluoranthene, benzo(k)fluoranthene and dibenz(a,h)anthracene were identified in Ned's Pond and Pond 2, the highest concentrations of acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(a)pyrene, and indeno(1,2,3-cd)pyrene were identified in the on-site marsh, the highest concentrations of naphthalene, perylene and acenaphthylene were identified in the reference areas, and the maximum concentration of benzo(ghi)perylene was identical on-site and in the reference areas.

In comparison to CCME (2001) Interim Sediment Quality Guidelines (ISQG) and the Probable Effects Level (PEL) for freshwater aquatic receptors, the following contaminants were identified in excess of either the ISQG or the ISQG and PEL:

*Ned's Pond* - Exceedences of ISQG:

- 5 of 5 samples for acenaphthene (and 1 of 3 QA samples)
- 5 of 5 samples for phenanthrene (and 1 of 3 QA samples)
- 4 of 5 samples for fluoranthene (and 1 of 3 QA samples)
- 5 of 5 samples for pyrene (and 1 of 3 QA samples)
- 3 of 5 samples for benzo(a)anthracene (and 1 of 3 QA samples)
- 4 of 5 samples for chrysene (and 1 of 3 QA samples)
- 3 of 5 samples for benzo(a)pyrene (and 1 of 3 QA samples)
- 3 of 5 samples for dibenz(a,h)anthracene (and 1 of 3 QA samples)

*Pond #2* - Exceedences of ISQG:

- 3 of 5 samples for acenaphthene
- 3 of 5 samples for phenanthrene
- 3 of 5 samples for pyrene

*On-site marsh* - Exceedences of ISQG:

- 1 of 6 samples for naphthalene (includes 2 QA samples analysed by both RPC and PAS)
- 2 of 6 samples for fluorene (includes 2 QA samples analysed by both RPC and PAS)
- 1 of 6 samples for fluorene (includes 2 QA samples analysed by both RPC and PAS)
- 1 of 6 samples for phenanthrene (includes 2 QA samples analysed by both RPC and PAS)
- 1 of 6 samples for anthracene (includes 2 QA samples analysed by both RPC and PAS)
- 2 of 6 samples for fluoranthene (includes 2 QA samples analysed by both RPC and PAS)
- 2 of 6 samples for pyrene (includes 2 QA samples analysed by both RPC and PAS)
- 2 of 6 samples for benzo(a)anthracene (includes 2 QA samples analysed by both RPC and PAS)
- 2 of 6 samples for chrysene (includes 2 QA samples analysed by both RPC and PAS)
- 1 of 6 samples for benzo(a)pyrene (includes 2 QA samples analysed by both RPC and PAS)

*On-site marsh* - Exceedences of ISQG and PEL:

- 1 of 6 samples for acenaphthene (includes 2 QA samples analysed by both RPC and PAS)
- 1 of 6 samples for phenanthrene (includes 2 QA samples analysed by both RPC and PAS)

*Black Duck Pond* - Exceedences of ISQG:

- 1 of 5 samples for acenaphthylene
- 1 of 5 samples for dibenz(a,h)anthracene

*Control Pond 2* - Exceedences of ISQG:

- 1 of 3 QA samples for naphthalene
- 1 of 5 samples for benzo(a)pyrene
- 2 of 5 samples for dibenz(a,h)anthracene

*Reference marsh* - no exceedences of CCME (2001)

Organochlorine Pesticides and PCBs:

The sediment organochlorine pesticide analytical results are presented in Table B.8 in Appendix B and are summarized in this section.

With the exception of one sediment sample collected in the on-site marsh in 1998 by ADI, which reportedly contained 1.1 mg/kg PCBs, no other sediment sample collected from Ned's Pond, Pond #2, the on-site marsh, or the reference ponds/marsh contained detectable concentrations of either organochlorine pesticides or PCBs. In addition, no fish tissue/carcass samples contained detectable concentrations of PCBs. PCBs would be expected to be present in fish if present in sediment, particularly sediment with a PCB concentration of 1.1 mg/kg, due to the hydrophobic and bioaccumulative nature of PCBs. Since no PCBs were identified in fish or in any other sediment sample analysed for PCBs, this one sample is believed to be a result of a laboratory or sampling error.

Metals:

The sediment metal analytical results are presented in Table B.11 in Appendix B and are summarized in Table 2.3. These results are presented in the same format as Table 2.2. The highlighted values indicate the location of the highest sediment metal concentration identified.

**Table 2.3: Summary of Maximum Sediment Metals Results**

| Sample Number | Maximum Concentration in Ned's Pond and Pond 2 (mg/kg) | Maximum Concentration in Ned's Pond, Pond 2 and On-site Marsh (mg/kg) | Maximum Concentration in Black Duck Pond, Control Pond 2 and Reference Marsh (mg/kg) | Maximum Concentration (all samples in all areas) (mg/kg) |
|---|---|---|---|---|
| Aluminum | 62400 | 66900 | 70000 | 70000 |
| Antimony | 0.8 | 1.2 | 1.2 | 1.2 |
| Arsenic | 6.3 | 6.3 | 9.2 | 9.2 |
| Barium | 381 | 381 | 401 | 401 |
| Beryllium | 1.4 | 1.4 | 1.7 | 1.7 |
| Boron | 33 | 33 | 34 | 34 |
| Cadmium | 1.2 | 1.2 | 3.5 | 3.5 |
| Chromium | 90 | 90 | 94 | 94 |
| Cobalt | 22.8 | 22.8 | 23.3 | 23.3 |
| Copper | 57 | 57 | 52 | 57 |
| Iron | 45400 | 45400 | 61300 | 61300 |
| Lead | 69.9 | 69.9 | 58.9 | 69.9 |
| Manganese | 1380 | 1380 | 9020 | 9020 |
| Molybdenum | 2.5 | 3.1 | 2.5 | 3.1 |
| Nickel | 45 | 45 | 49 | 49 |
| Selenium | 4 | 4 | 6 | 6 |
| Silver | 0.3 | 0.3 | 0.5 | 0.5 |
| Strontium | 128 | 183 | 239 | 239 |
| Thallium | 0.3 | 0.3 | 0.6 | 0.6 |
| Tin | 5 | 5 | 53.6 | 53.6 |
| Uranium | 3.5 | 3.5 | 4.9 | 4.9 |
| Vanadium | 109.5 | 131 | 159 | 159 |
| Zinc | 250 | 586 | 336 | 586 |
| Mercury | 0.195624657 | 0.195624657 | 0.22965629 | 0.22965629 |

As presented in Table 2.3, the highest concentrations of copper and lead were identified in Ned's Pond and Pond 2, the highest concentrations of molybdenum and zinc were identified in the on-site marsh, the highest concentrations of all other metals were identified in the reference areas.

In comparison to CCME (2001) ISQGs and PELs for freshwater aquatic receptors and the Ontario Ministry of the Environment sediment quality guidelines, the following contaminants were identified in excess of MOE guidelines, the ISQG or the ISQG and PEL:

*Ned's Pond* - Exceedences of ISQG:
- 1 of 3 QA samples for arsenic
- 5 of 5 samples for cadmium (and 2 of 3 QA samples)
- 3 of 5 samples for chromium (and 3 of 3 QA samples)
- 1 of 5 samples for copper (and 1 of 3 QA samples)
- 3 of 5 samples for lead (and 3 of 3 QA samples)
- 3 of 5 samples for zinc (and 3 of 3 QA samples)
- 2 of 5 samples for mercury (and 2 of 3 QA samples)

*Ned's Pond* - Exceedences of MOE (1993):
- 5 of 5 samples for manganese (and 3 of 3 QA samples)
- 3 of 5 samples for nickel (and 3 of 3 QA samples)

*Pond #2* - Exceedences of ISQG:
- 4 of 5 samples for cadmium (and 2 of 3 QA samples)

- 5 of 5 for samples chromium (and 3 of 3 QA samples)
- 2 of 5 samples for copper
- 5 of 5 samples for zinc (and 2 of 3 QA samples)

*Pond #2*- Exceedences of MOE (1993):

- 5 of 5 samples for manganese (and 2 of 3 QA samples)
- 4 of 5 samples for nickel (and 3 of 3 QA samples)

*On-site marsh* - Exceedences of ISQG:

- 1 of 6 samples for arsenic (includes 2 QA samples analysed by both RPC and PAS)
- 2 of 6 samples for cadmium (includes 2 QA samples analysed by both RPC and PAS)
- 3 of 6 samples for chromium (includes 2 QA samples analysed by both RPC and PAS)
- 2 of 6 samples for copper (includes 2 QA samples analysed by both RPC and PAS)
- 1 of 6 samples for lead (includes 2 QA samples analysed by both RPC and PAS)
- 3 of 6 samples for zinc (includes 2 QA samples analysed by both RPC and PAS)
- 1 of 6 samples for mercury (includes 2 QA samples analysed by both RPC and PAS)

*On-site marsh* - Exceedences of ISQG and PEL:

- 1 of 6 samples for zinc (includes 2 QA samples analysed by both RPC and PAS)

*On-site marsh* - Exceedences of MOE (1993):

- 2 of 6 samples for manganese (includes 2 QA samples analysed by both RPC and PAS)
- 4 of 6 for samples for nickel (includes 2 QA samples analysed by both RPC and PAS)

*Black Duck Pond* - Exceedences of ISQG:

- 1 of 5 samples for arsenic (and 3 of 3 QA samples)
- 5 of 5 samples for cadmium (and 2 of 3 QA samples)
- 5 of 5 samples for chromium (and 2 of 3 QA samples)
- 2 of 5 samples for lead (and 3 of 3 QA samples)
- 5 of 5 samples for zinc (and 3 of 3 QA samples)
- 3 of 5 samples for mercury (and 3 of 3 QA samples)

*Black Duck Pond*- Exceedences of MOE (1993):

- 5 of 5 samples for manganese (and 2 of 3 QA samples)
- 5 of 5 samples for nickel (and 3 of 3 QA samples)

*Control Pond 2* - Exceedences of ISQG

- 1 of 5 samples for arsenic (and 3 of 3 QA samples)
- 5 of 5 samples for cadmium (and 2 of 3 QA samples)
- 4 of 5 samples for chromium (and 1 of 3 QA samples)
- 1 of 5 samples for copper (and 1 of 3 QA samples)
- 5 of 5 samples for lead (and 3 of 3 QA samples)
- 3 of 5 samples for zinc (and 3 of 3 QA samples)
- 2 of 5 samples for mercury (and 3 of 3 QA samples)

*Control Pond 2*- Exceedences of ISQG and PEL:

- 2 of 5 samples for zinc

*Control Pond 2* - Exceedences of MOE (1993):

- 5 of 5 samples for manganese (and 3 of 3 QA samples)
- 5 of 5 samples for nickel (and 3 of 3 QA samples)

*Reference marsh* - Exceedences of ISQG and/or PEL

- 1 of 4 samples for chromium exceeded the ISQG (includes 2 QA samples analysed by both RPC and PAS)
- 2 of 4 samples for chromium exceeded the ISQG and PEL (includes 2 QA samples analysed by both RPC and PAS)

*Reference Marsh* - Exceedences of MOE (1993):

- 2 of 4 samples for manganese (and 3 of 3 QA samples)
- 4 of 4 samples for nickel (includes 2 QA samples analysed by both RPC and PAS)

### 2.3.1.2 Water

TPH:
The surface water TPH analytical results are presented in Table B.4 in Appendix B and are summarized in this section.

No detectable hydrocarbons were identified in the surface water samples analysed from Ned's Pond, Pond #2, Black Duck Pond, and Control Pond 2.

PAHs:
The surface water PAH analytical results are presented in Table B.6 in Appendix B and are summarized in this section.

Only one surface water sample from Pond #2 contained detectable concentrations of phenanthrene, anthracene, fluoranthene, and pyrene. Two samples from Black Duck Pond and one sample from Control Pond 2 contained detectable concentrations of naphthalene. No surface water PAH concentrations exceeded the applicable CCME (2001) guidelines.

Organochlorine Pesticides:
The surface water organochlorine pesticide analytical results are presented in Table B.9 in Appendix B and are summarized in this section.

No detectable organochlorine pesticides or PCBs were identified in the surface water samples analysed from Ned's Pond, Pond #2, Black Duck Pond, and Control Pond 2.

Metals:
The surface water metals analytical results are presented in Table B.13 in Appendix B and are summarized in Table 2.4. The highlighted values indicate the location of the highest surface water metal concentration identified.

**Table 2.4 Summary of Maximum Surface Water Metals Results**

| Parameter | Maximum Concentration in Ned's Pond and Pond 2<br>ug/L | Maximum Concentration in Black Duck Pond and Control Pond 2<br>ug/L | Maximum Concentration (all samples in all areas)<br>ug/L |
|---|---|---|---|
| Aluminum | 105.0 | 87.0 | 105.0 |
| Antimony | 0.1 | nd | 0.1 |
| Arsenic | nd | nd | nd |
| Barium | 29.0 | 7.0 | 29.0 |
| Beryllium | 0.1 | nd | 0.1 |
| Boron | 10.0 | 5.0 | 10.0 |
| Cadmium | 0.2 | nd | 0.2 |
| Chromium | 2.0 | 2.0 | 2.0 |
| Cobalt | 0.1 | nd | 0.1 |
| Copper | 12.0 | 1.0 | 12.0 |
| Iron | 180.0 | 170.0 | 180.0 |
| Lead | 5.3 | 10.6 | 10.6 |
| Manganese | 13.0 | 99.0 | 99.0 |
| Molybdenum | 0.1 | 0.2 | 0.2 |
| Nickel | 2.0 | 1.0 | 2.0 |
| Selenium | 1.0 | nd | 1.0 |
| Silver | 0.1 | nd | 0.1 |
| Strontium | 94.0 | 47.0 | 94.0 |

**Table 2.4 Summary of Maximum Surface Water Metals Results**

| Parameter | Maximum Concentration in Ned's Pond and Pond 2 ug/L | Maximum Concentration in Black Duck Pond and Control Pond 2 ug/L | Maximum Concentration (all samples in all areas) ug/L |
|---|---|---|---|
| Thallium | 0.1 | nd | 0.1 |
| Uranium | 0.2 | 0.1 | 0.2 |
| Vanadium | nd | nd | nd |
| Zinc | 29.0 | 7.0 | 29.0 |
| Mercury | 0.4 | 0.1 | 0.4 |

As presented in Table 2.4, the highest concentrations of aluminum, antimony, barium, beryllium, boron, cadmium, cobalt, copper, iron, nickel, selenium, silver, strontium, thallium, uranium, zinc and mercury were identified in Ned's Pond and Pond 2, and the highest concentrations of lead, manganese and molybdenum were identified in the reference areas.

In comparison to CCME (2001) water quality guidelines for the protection of aquatic life, the following contaminants were identified in excess of CCME (2001):

*Ned's Pond* -no exceedences
*Pond #2* - Exceedences of CCME (2001)
- 1 of 5 samples for aluminum
- 1 of 5 samples for cadmium
- 1 of 5 samples for copper
- 1 of 5 samples for mercury

*Black Duck Pond* - Exceedences of CCME (2001)
- 2 of 5 samples for mercury

*Control Pond 2* - Exceedences of CCME (2001)
- 1 of 5 samples for lead

General Water Chemistry:
The surface water general chemistry analytical results are presented in Table B.12 in Appendix B and are summarized in Table 2.5. The highlighted values indicate the location of the highest general water chemistry result identified.

**Table 2.5: Summary of Maximum Surface Water General Chemistry Results**

| Parameter | Maximum Concentration in Ned's Pond and Pond 2 mg/L | Maximum Concentration in Black Duck Pond and Control Pond 2 mg/L | Maximum Concentration (all samples in all areas) mg/L |
|---|---|---|---|
| Sodium | 69.8 | 4.69 | 69.8 |
| Potassium | 1.2 | 0.41 | 1.2 |
| Calcium | 49.6 | 27.3 | 49.6 |
| Magnesium | 10.6 | 6.99 | 10.6 |
| Ammonia (as N) | 0.05 | <0.05 | 0.05 |
| pH (units) | 7.77 | 7.86 | 7.86 |
| Alkalinity (as CaCO3) | 87 | 95.9 | 95.9 |
| Chloride | 51.7 | 8 | 51.7 |
| Sulfate | 4.9 | 3.9 | 4.9 |
| Nitrate + Nitrite (as N) | 0.17 | 0.1 | 0.17 |
| o-Phosphate (as P) | 0.01 | <0.01 | 0.01 |
| r-Silica (as $SiO_2$) | 4.7 | 3.9 | 4.7 |

**Table 2.5: Summary of Maximum Surface Water General Chemistry Results**

| Parameter | Maximum Concentration in Ned's Pond and Pond 2<br>mg/L | Maximum Concentration in Black Duck Pond and Control Pond 2<br>mg/L | Maximum Concentration (all samples in all areas)<br>mg/L |
|---|---|---|---|
| Total Organic Carbon (TOC) | 12.2 | 9.3 | 12.2 |
| Turbidity (NTU or nephelometric turbidity units) | 1.62 | 1.55 | 1.62 |
| Total Suspended Solids | 5 | 6 | 6 |
| Conductivity (uS/cm) | 327 | 192 | 327 |

As presented in Table 2.5, with the exception of pH, alkalinity and total suspended solids, all of the parameters assessed were higher in Ned's Pond and Pond 2 than in the reference areas.

In comparison to CCME (2001) water quality guidelines for the protection of aquatic life, the following contaminants were identified in excess of CCME (2001):

*Ned's Pond* -Exceedences of CCME (2001)
- 1 of 5 samples for nitrate + nitrite

*Pond #2* - Exceedences of CCME (2001)
- 5 of 5 samples for nitrate + nitrite

*Control Pond 2* - Exceedences of CCME (2001)
- 3 of 5 samples for nitrate + nitrite

### 2.3.1.3 Fish

PAHs:
The fish carcass and tissue PAH analytical results are presented in Table B.7 in Appendix B and are summarized in this section.

Detectable concentrations of naphthalene were identified fish carcasses and fillets at all sites. Only one fish (Control Pond 2 Fillet #1), did not have detectable concentrations of naphthalene. Low concentrations of phenanthrene were identified in one carcass from Ned's Pond and one from Black Duck Pond. Fish naphthalene and phenanthrene concentrations in Ned's Pond and Pond #2 were very similar to concentrations identified in the fish from the reference ponds, and were not qualitatively considered different enough to warrant further consideration (difference between the two maximum values was 0.02 mg/kg). Due to the low number of samples with detectable concentrations, no P-values could be calculated for these parameters. Acenaphthene was identified in two carcasses from Ned's Pond only at a concentration of 0.01 mg/kg. No other PAHs were identified.

Organochlorine Pesticides:
The fish carcass and tissue organochlorine pesticide analytical results are presented in Table B.10 in Appendix B and are summarized in this section.

No detectable organochlorine pesticides or PCBs were identified in the fish carcass or fillet samples analysed from Ned's Pond, Pond #2, Black Duck Pond, or Control Pond 2.

Metals
The fish carcass and tissue metals analytical results are presented in Table B.14 in Appendix B and are summarized in Table 2.6. Table 2.6 presents the mean fish tissue and carcass concentrations from samples collected in Ned's Pond and Pond #2, and in Black Duck Pond and Control Pond 2. The highlighted values in the table represent the location of the highest mean metal concentration for both tissue and carcasses.

All results were reported on a wet weight basis. The mean size and lipid content of the fish from Ned's Pond/Pond #2 and Black Duck Pond/Control Pond 2 were assumed to be similar, based on size and weight measurements taken during the field program. By averaging the fish contaminant concentrations from fish collected in each area (on-site and the reference area), any variations in size or lipid content were considered to have been accounted for. Thus 'normalizing' the metals data based on fish-specific lipid concentrations was considered unnecessary for the qualitative ecological risk assessment portion of this study.

**Table 2.6: Summary of Mean Fish Tissue and Carcass Metals Results**

| Parameter | Mean Carcass Concentrations - Ned's Pond and Pond #2 (mg/kg) | Mean Carcass Concentrations - Black Duck Pond and Control Pond 2 (mg/kg) | Mean Fillet Concentrations - Ned's Pond and Pond #2 (mg/kg) | Mean Fillet Concentrations - Black Duck Pond and Control Pond 2 (mg/kg) |
|---|---|---|---|---|
| Aluminum | 3.442 | 13.5633 | 0.48 | 0.77 |
| Antimony | nd | nd | nd | nd |
| Arsenic | nd | 0.05 | 0.05 | 0.09 |
| Barium | 0.326 | 0.3467 | 0.065 | 0.05 |
| Beryllium | nd | nd | nd | nd |
| Boron | nd | nd | nd | nd |
| Cadmium | 0.0135 | 0.016 | 0.005 | nd |
| Chromium | 0.33 | 0.810 | 0.204 | 0.23 |
| Cobalt | 0.0308 | 0.0310 | 0.0132 | 0.014 |
| Copper | 0.914 | 0.7267 | 0.362 | 0.5425 |
| Iron | 30.4 | 32.33 | 4.4 | 5 |
| Lead | 0.0464 | 0.0627 | 0.0196 | 0.04625 |
| Manganese | 4.34 | 6.9933 | 0.572 | 0.9075 |
| Molybdenum | 0.0638 | 0.1393 | 0.034 | 0.037 |
| Nickel | 0.266 | 0.5800 | 0.15 | 0.155 |
| Selenium | 0.292 | 0.3100 | 0.216 | 0.2225 |
| Silver | 0.0065 | 0.0097 | nd | nd |
| Strontium | 2.318 | 2.6067 | 0.328 | 0.3825 |
| Thallium | nd | 0.0070 | nd | nd |
| Uranium | nd | nd | nd | nd |
| Vanadium | 0.09 | 0.0600 | nd | nd |
| Zinc | 20.32 | 22.0667 | 7.162 | 9.715 |
| Mercury | 0.0364 | 0.0220 | 0.052 | 0.02875 |

Notes: nd = not detected

As presented in Table 2.6, metals concentrations in fish were generally higher in the reference areas (Black Duck Pond and Control Pond 2) than in Ned's Pond or Pond #2. For fish tissue, slightly higher copper, vanadium and mercury concentrations were identified in Ned's Pond/Pond #2, and for fish carcasses, slightly higher barium, cadmium and mercury concentrations were identified.

The average metals concentrations in fish carcasses or tissues which exceeded the reference area concentrations have been compared to applicable screening criteria (CCME, 2001). The only available criteria is for methylmercury, and all fish from all locations (with the exception of one fish from Control Pond 2) exceeded the CCME (2001) tissue residue methylmercury guideline for the protection of wildlife consumers of aquatic biota.

#### 2.3.1.4 Statistical Significance Between Sediment and Surface Water Concentrations On-Site and the Reference Areas

The test of significance assesses the evidence against a null hypothesis in terms of probability. If the observed outcome is unlikely under the supposition that the null hypothesis is true, but is more probable if the alternative hypothesis is true, that outcome is evidence against the null hypothesis in favor of the alternative hypothesis. The less probable the outcome is, the stronger the evidence is that

the null hypothesis is false. The probability of getting a value of the sample test statistic that would have a value that is at least as extreme as the one from the sample data, assuming that the null hypothesis is true, is called the P-value of the test. The P-value measures the confidence in rejecting the null hypothesis. The smaller the P-value, the stronger the evidence against the null hypothesis provided by the data. A P-value of 0.05 was selected for this study as it indicates the evidence against the null hypothesis is so strong that it would happen no more than 5% of the time. The data is therefore statistically significant at a level of 0.05.

Using SYSTAT, Version 8.0, an analysis of variance (ANOVA) was conducted for metals and PAHs in sediment from Ned's Pond, Pond #2, the on-site marsh, Black Duck Pond, Control Pond 2 and the reference marsh, and for metals and general chemistry in surface water from Ned's Pond, Pond #2, Black Duck Pond and Control Pond 2. Only those parameters whose maximum on-site concentration exceeded the maximum concentration from the reference areas were tested using ANOVA. ANOVA was used to determine whether the contaminant concentrations from the on-site sampling locations were significantly different from the concentrations from the reference areas. Due to the limited number of fish tissue and carcass samples and the limited number of sediment and surface water samples with detectable concentrations of the remaining parameters, these samples were not assessed for statistical significance. Results were considered statistically significant where the P-value was <0.05. Those substances with P-values <0.05 were therefore considered to be potential parameters of concern and are further assessed in the risk assessment.

Based on the ANOVA results, the following substances had P-values <0.05 (and were considered significantly different from the reference areas): lead in sediment; and aluminum, barium, boron, calcium, chloride, iron, manganese, magnesium, nitrate/nitrite, potassium, r-silica, sodium, strontium, sulfate, total organic carbon, and conductivity in surface water. A summary of the ANOVA results for each site, including geometric mean, standard deviation, and P-values for those substances with P-values <0.05 are presented in Table 2.7.

**Table 2.7: ANOVA Results**

| Site | Parameter | Geometric Mean | Standard Deviation | P-Values (Compared to Reference Areas) |
|---|---|---|---|---|
| **Ned's Pond** | | | | |
| Surface Water | Sodium | 18.42 | 17.332 | 0.005 (BD); 0.003 (CP2) |
| | Potassium | 0.563 | 0.226 | 0.003 (BD); 0.001 (CP2) |
| | Magnesium | 5.413 | 2.211 | 0.000 (BD) |
| | Iron | 0.133 | 0.055 | 0.000 (CP2) |
| | Manganese | 0.027 | 0.033 | 0.000 (CP2) |
| | Chloride | 27.965 | 21.864 | 0.000 (BD); 0.000 (CP2) |
| | Sulfate | 3.735 | 0.553 | 0.004 (BD) |
| | R-Silica | 3.82 | 0.872 | 0.000 (BD); 0.000 (CP2) |
| | TOC | 8.205 | 3.539 | 0.000 (BD); 0.000 (CP2) |
| | Conductivity | 232.75 | 86.775 | 0.000 (BD); 0.000 (CP2) |
| | Aluminum | 65.6 | 35.892 | 0.000 (CP2) |
| | Barium | 11.25 | 6.423 | 0.003 (BD); 0.001 (P2) |
| | Iron | 133.5 | 54.799 | 0.000 (CP2) |
| Sediment | Lead | 29.213 | 15.925 | 0.004 (RM) |
| **Pond #2** | | | | |
| Surface Water | Sodium | 18.42 | 17.332 | 0.000 (BD); 0.000 (CP2) |
| | Potassium | 0.563 | 0.226 | 0.000 (BD); 0.000 (CP2) |
| | Calcium | 24.6 | 7.411 | 0.001 (BD) |
| | Magnesium | 5.413 | 2.211 | 0.000(BD) |
| | Iron | 0.133 | 0.055 | 0.000 (CP2); 0.036 (NP) |
| | Manganese | 0.027 | 0.033 | 0.000 (CP2) |
| | Chloride | 27.965 | 21.864 | 0.000 (BD); 0.000 (CP2) |
| | Sulfate | 3.735 | 0.553 | 0.000 (BD); 0.001 (CP2) |
| | Nitrate/Nitrite | 0.084 | 0.04 | 0.000 (BD); 0.000 (CP2); 0.000 (NP) |
| | R-Silica | 3.82 | 0.872 | 0.000 (BD); 0.000 (CP2); 0.000 (NP) |

**Table 2.7: ANOVA Results**

| Site | Parameter | Geometric Mean | Standard Deviation | P-Values (Compared to Reference Areas) |
|---|---|---|---|---|
| | TOC | 8.205 | 3.539 | 0.000 (CP2); 0.000 (NP) |
| | Conductivity | 232.75 | 86.775 | 0.000 (BD); 0.000 (CP2); 0.000 (NP) |
| | Aluminum | 65.6 | 35.892 | 0.000 (CP2) |
| | Barium | 11.25 | 6.423 | 0.000 (BD); 0.000 (CP2) |
| | Boron | 5.05 | 1.432 | 0.019 (BD); 0.035 (CP2) |
| | Iron | 133.5 | 54.799 | 0.000 (CP2); 0.036 (NP) |
| | Strontium | 42.55 | 13.367 | 0.021 (BD) |
| Sediment | Lead | 29.213 | 15.925 | |
| **On-site Marsh** | | | | |
| Sediment | Lead | 29.213 | 15.925 | 0.006 (CP2); 0.019 (NP) |
| Notes: BD = Black Duck Pond, CP2 = Control Pond 2, NP = Ned's Pond, and RM = Reference Marsh | | | | |

Typical Canadian Water Parameter Concentrations

None of the following surface water parameters are considered to be the result of anthropogenic activity: boron; calcium; chloride; conductivity; iron; magnesium; manganese; nitrate/nitrite; potassium; r-silica; sodium; sulfate; and total organic carbon (TOC).

Elevated sodium and chloride concentrations in surface water on-site likely indicate that Ned's Pond and Pond #2 have a higher salinity than the reference areas. The higher sodium and chloride concentrations are likely the reason for the elevated conductivity identified in Ned's Pond and Pond #2 in comparison to the reference areas.

Boron, calcium, iron, magnesium, manganese, potassium, r-silica, and sulfate are likely the result of the erosion and subsequent leaching of these substances from soil or bedrock. TOC is likely the result of the presence of aquatic vegetation and aquatic organisms (which contain organic carbon), however, it may also be formed through photosynthesis in the aquatic environment (CCREM, 1987). Nitrates/nitrites are naturally occurring ions ubiquitous in the environment that are the products of the oxidation of nitrogen by organisms in plants, soil, or water (Health Canada, 1992). Elevated nitrate/nitrite levels may be indicative of the presence of decaying plant or animal material, fertilizers, domestic sewage or geological formations containing soluble nitrogen compounds (Health Canada, 1992).

Table 2.8 presents the typical Canadian concentrations of these parameters (Atlantic Canada data where available) and the maximum site concentration in comparison:

**Table 2.8 Typical Canadian General Water Chemistry Parameter Concentrations in Comparison to Site Concentrations**

| Substance | Typical Concentration | Maximum Site Concentration |
|---|---|---|
| Boron | 0.16 mg/L median Canada-wide surface water concentration; Newfoundland and Labrador municipal water supplies contained less than 0.02 mg/L (Health Canada, 1990) | 0.01 mg/L |
| Calcium | 30-100 mg/L in water close to carbonate rocks | 49.6 mg/L |
| Iron | less than 0.5 mg/L in aerated waters | 0.18 mg/L |
| Magnesium | 1-100 mg/L in watersheds with magnesium-containing rocks | 10.6 mg/L |
| Manganese | 0.01-3.8 mg/L in Atlantic Canada with national typical concentration of 0.2 mg/L or less | 0.013 mg/L |
| Nitrate/ nitrite | Nitrate levels in Canadian municipal water supplies are generally less than 5 mg/L, with surface water supplies often containing lower concentrations than well water (Health Canada, 1992) | 0.17 mg/L |
| Potassium | 0.01-32 mg/L in Atlantic Canada with national typical concentration generally less than 10 mg/L | 1.2 mg/L |
| R-Silica | 0.01-24 mg/L in Atlantic Canada, with most natural waters containing less than 5 mg/L silica, although a range of 1-30 mg/L is not considered uncommon | 4.7 mg/L |
| Sulfate | Typical concentrations normally vary from 10-80 mg/L in surface water | 4.9 mg/L |

**Table 2.8 Typical Canadian General Water Chemistry Parameter Concentrations in Comparison to Site Concentrations**

| Substance | Typical Concentration | Maximum Site Concentration |
|---|---|---|
| TOC | 1-30 mg/L in natural waters, with the range in Atlantic Canada from 0.01-183 mg/L | 12.2 mg/L |
| National Data Source: CCREM, 1987 (except where otherwise indicated) | | |

As presented in Table 2.8, none of the parameters considered to be naturally occurring exceeded the national or Atlantic Region (where available) typical surface water concentrations. Therefore, these substances have not been carried forward in the risk assessment.

### 2.3.1.5 Toxicity Testing

Toxicity test results are presented in Table B.2 in Appendix B and are summarized in this section.

Sediment from Ned's Pond, Pond #2, the on-site marsh, Black Duck Pond, Control Pond 2, and the reference marsh were tested for toxicity using two separate tests: 1) an amphipod test (*Hyalella azteca*) and 2) Microtox™ Solid-Phase test (hereinafter referred to as Microtox test) using the bacterium *Vibrio fischeri*. The applicable protocols for each of these tests are presented in Environment Canada (2001 and 2002b) and are not further discussed here.

The results of the amphipod test indicated that the survival rate ranged from 90% ± 7.1 in Ned's Pond Sample 3 Station 5, to 100% ± 0 in the Control Pond 2, Black Duck Pond, Pond #2 Sample 1 Station 3, Ned's Pond Sample 2, Reference Marsh Station 1 Sample 1 and Reference Marsh Station 1 Sample 2. The results of all of the samples from the study area and the controls indicate a good survival rate and negligible toxicity.

The Microtox test results were compared to the *Interim Guideline for the Environment Canada Ocean Disposal Program* (Environment Canada 1996a and 2000), which states that a sample is considered 'toxic' if the EC50 is less than 1000 mg/L corrected for dry weight of solids. The EC50s for each of the samples ranged from 1240 mg dry sediment/L diluent in Pond #2 Sample 1 Station 1 to 40,300 mg dry sediment/L diluent in the reference marsh, and therefore, none of the samples are considered 'toxic' based on the definition provided by Environment Canada (1996a and 2000).

### 2.3.2 Laboratory QA/QC

In order to assess the potential for laboratory Quality Assurance/Quality Control (QA/QC) inconsistencies, four sediment samples were submitted to three different labs for the same analyses (one from Ned's Pond, Pond #2, Black Duck Pond and Control Pond 2).

The four sediment samples submitted to each of the three labs were a composite of all five sediment samples collected from each of four the ponds sampled (Ned's Pond, Pond 2, Black Duck Pond and Control Pond 2). The individual samples had been previously submitted to ECB for analysis, and Environment Canada lab staff homogenized the remaining sediment from each pond upon completion of their analyses. These homogenized samples were then submitted to RPC and PAS, and all three labs (including ECB) analysed the samples for TPH, PAHs, metals, organochlorine pesticides, and PCBs.

In addition to these four sediment samples, two sediment samples (one from the on-site marsh and the other from the reference marsh) were submitted to both RPC and PAS for TPH, PAHs, organochlorine pesticides and metals.

<u>TPH</u>

For TPH, due to the different analytical techniques used (RPC and PAS used the Alberta MUST protocol, and ECB used the Canada-Wide Standard protocol), the three results cannot be accurately compared. In comparing the RPC and PAS TPH results, the PAS results were higher than RPC (i.e. 560 mg/kg compared to 98 mg/kg; 430 mg/kg compared to not detected).

Metals

For metals, the three lab results in general reported similar results. The RPC results tended to be highest, with similar, but slightly lower concentrations reported by ECB, and the lowest concentrations reported by PAS. For several metals, including aluminum, barium, iron, strontium, and vanadium, the PAS results were approximately 50% lower than the RPC or ECB results.

PAHs

For PAHs, again the RPC and ECB results were similar, with RPC results typically slightly higher than ECB, except for naphthalene, where the ECB results were consistently higher. PAS reported perylene as the only detected PAH, however, neither RPC nor ECB typically report perylene in their suite of PAHs. Therefore, comparisons between PAS, RPC and EPB for perylene were not possible.

The inability to compare perylene concentrations across labs is of concern because perylene was identified by Cantox as an anomalous substance in sediment which may be the result of interference in the analysis or may be another substance resembling perylene. In discussions with PAS (Gilbert, 2002 personal communication) regarding the presence of perylene, scientific literature has indicated that perylene may be naturally occurring as a result of a reduction of naturally synthesized compounds under anaerobic conditions (OSPAR, 2000). Thus, the presence of perylene in natural systems may not necessarily be indicative of anthropogenic sources of perylene. In addition, the maximum perylene concentration identified in sediment was 10 mg/kg in Black Duck Pond, which exceeded the maximum of 5 mg/kg identified in Pond #2. Therefore, the maximum perylene concentration in the sediment in the on-site ponds is lower than the concentration in the sediment from the reference area, and its presence may be the result of naturally occurring conditions.

Organochlorine Pesticides

No organochlorine pesticides or PCBs were detected in any of the sediment samples analysed at the three labs.

Although PCBs were identified in one sample collected in Ned's Pond by ADI (1998) (SED-P#2 at 1.1 mg/kg Aroclor 1254) which was collected in the on-site marsh, no other sediment samples collected in the vicinity of this sample have contained detectable concentrations of PCBs (detection limit of 0.05 mg/kg). In addition, no PCBs have been identified in the soil or groundwater at the site (Cantox, 2001) or in any of the fish tested during the most recent sampling program. Therefore, this sample result is believed to be an anomaly and is not considered to be representative of typical sediment concentrations in the on-site marsh.

### 2.3.3 Potential Rationale For Differences

The differences in the results between the three labs may be due to a variety of reasons, including different analytical procedures used to analyse the samples, or different equipment calibrations and different analytical detection limits for each of the analyses.

Different Laboratory Analytical Methodologies

*TPH*

For TPH, RPC and PAS utilized methods similar to the Alberta MUST procedure for analysing volatile and extractable components of the TPH mixture. The Alberta MUST procedure typically involves the use of a purge and trap or headspace analysis method to obtain accurate values for the volatile fractions (typically C6-C10), and an extraction method to capture the heavier fractions (C10-C35).

For purgeables, the PAS methodology involves extracting the sample with methanol and analysing it using a GC-PID-FID (gas chromatogram - photo-ionization detector - flame ionization detector). For extractables, PAS uses an acetone/hexane extraction process with analysis by GC/FID. For purgeables, RPC uses a purge and trap concentrator and analysis by GC-MS (gas chromatogram-mass spectrometer). For extractables, RPC uses either a hexane or cyclopentane extraction process with analysis by GC/FID. The two methodologies are very similar, although PAS consistently produced the highest results of the two labs. Therefore, the analytical methodology is not likely the reason for the difference in results.

*Metals*

For metals, RPC and ECB utilize nitric and hydrofluoric acid digestion, whereas PAS utilizes a nitric/peroxide digestion. The result is that the RPC and ECB methodology breaks down silicates (provides a 'total metals' analysis) whereas the PAS methodology does not, providing a result similar to 'bioavailable' metals analysis, with the resultant concentrations lower in the PAS results. Thus, the differences in metals results between the labs may be attributed to the different analytical methodologies.

*PAHs*

For PAHs, both PAS and ECB use a acetone/hexane extraction process with analysis by GC-MS SIM Mode (single ion monitoring system). RPC uses either methylene chloride or acetone/hexane extraction, with analysis by GC-MS. The RPC and ECB results were very similar, however the PAS results were consistently lower. All labs use the same methodology, therefore the different results between PAS and the other two labs is not due to the analytical methodology used to analyse for PAHs.

Different Equipment Calibrations/Variations in Analytical Detection Limits

At low concentrations, if equipment is calibrated for higher concentrations, it may be more difficult to accurately read the measured concentration due to the shorter low-end range on the chromatogram.

Similarly, if the equipment analytical detection limits are higher in one lab than in another, lower chemical concentrations may not be detected by the lab with the higher detection limit. For TPH, PAS had a lower standard detection limit for the C10-C21 and C21-C32 fraction ranges than RPC, which may account for the consistently higher detected concentrations reported by PAS.

In addition, for PAHs, the standard detection limit identified by PAS was 0.05 mg/kg, compared to 0.01 mg/kg for RPC and 0.005 mg/kg for ECB. The higher detection limit used by PAS may account for the consistently non-detectable PAH concentrations in comparison to RPC and ECB. Thus, the differences in detection limits may be the reason the results differ between the labs for TPH and PAHs.

# 3. SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

## 3.1 Receptor Identification

The focus of this ecological risk assessment is on the potential risks of parameters of concern (POCs) in the sediment and surface water to non-human receptors (including both aquatic and terrestrial-based receptors) in Ned's Pond, Pond #2 and the on-site marsh.

Ecological receptors in Ned's Pond, Pond #2, or the on-site marsh may be exposed to POCs in the ponds through the following exposure pathways:

- Direct uptake of POCs in the water by terrestrial or aquatic biota (ingestion, direct contact and sorption through skin/membranes);
- Direct uptake of POCs in the sediment by terrestrial or aquatic biota (ingestion, direct contact and sorption through skin/membranes);
- Ingestion of impacted biota by other organisms; and/or
- Biomagnification up the food chain.

Based on habitat types and the receptors identified during the field program, potential ecological receptors in the ponds and/or marsh may include:

**Table 3.1: Potential Ecological Receptors**

| Receptor | Information Compiled | Relevance as a Receptor |
|---|---|---|
| Benthic Infauna and Epifauna | Insect larvae; Crustaceans (i.e. amphipods); Copepods; Worms (i.e. oligochaete); Gastropods; Bivalve molluscs; Rotifers; Nematodes | Primary receptors of POCs in sediment due to their close contact with sediment, potential ingestion of sediment, and contact with and ingestion of water |
| Fish | American Eel (*Anguilla rostrata*)<br>Brook Trout (*Salvelinus fontinalis*)<br>Three-spine Stickleback (*Gasterosteus aculaetus*) | Potential for direct contact and/or ingestion of POCs in sediment and surface water; ingestion of other organisms in the food chain which may accumulate the POCs |
| Reptiles and Amphibians | American Toad (*Bufo americanus*)<br>No other reptiles or amphibians were identified as being potentially present in the study area | Potential for direct contact and/or ingestion of POCs in sediment and surface water; ingestion of other organisms in the food chain which may accumulate the POCs |
| Mammals | American Beaver (*Castor canadensis*)<br>Muskrat (*Ondatra zibethicus*)<br>River Otter (*Lutra canadensis*)<br>Mink (*Mustela vison*) | Potential for direct contact and/or ingestion of POCs in the sediment and surface water; ingestion of other organisms in the food chain which may accumulate the POCs |
| Birds | Canada Goose (*Branta canadensis*)<br>Green Winged Teal (*Anas crecca*)<br>American Black Duck (*Anas rubripes*)<br>Common Goldeneye (*Bucephala clangula*)<br>Osprey (*Pandion haliaetus*)<br>Bald Eagle (*Haliaeetus leucocephalus*)<br>Belted Kingfisher (*Ceryle alcyon*) | Potential for direct contact and/or ingestion of POCs in the sediment and surface water; ingestion of other organisms in the food chain which may accumulate the POCs |
| Sources: Atlantic Canada Conservation Data Centre (2002); Nova Scotia Museum of Natural History (2002); Julien, G (2002) | | |

### 3.1.1 Valued Environmental Components (VECs)

According to Beanlands and Duinker (1983) as defined in CCME (1996), VECs are non-human resources or environmental features that:

- Are important to human populations;

- Have economic and/or social value;
- Have intrinsic ecological significance; and/or
- Serve as a baseline from which the impacts of development can be evaluated, including changes in management or regulatory policies.

Based on a review of the potential receptors in Ned's Pond, Pond #2 and the on-site marsh, the following VECs have been selected:

- Benthic Infauna;
- Brook Trout (*Salvelinus fontinalis*);
- American Black Duck (*Anas rubripes*); and
- Mink (*Mustela vison*).

Benthic Infauna

Benthic infauna are multi-cellular organisms that inhabit the sediment. They have been selected as a VEC because of their on-going exposure to potential POCs in the sediment and surface water through direct contact and/or incidental ingestion. In addition, they can act as bio-indicators of sediment quality in that they are likely to be adversely affected by any identified elevated levels of POCs (if present) in the sediment of Ned's Pond, Pond #2 or the on-site marsh.

Brook Trout

Brook trout were identified in Ned's Pond and Pond #2 during the site visit and were collected for PAH, metal, PCB, and organochlorine pesticide analyses. Brook trout were selected as a VEC because they are important food fish for human consumption.

American Black Duck

The American Black Duck was selected as the VEC to represent all other bird species due to its expected presence in Ned's Pond and Pond #2 and the suitability of nearby habitat for breeding. Black Ducks are important to humans as they are hunted for food. In addition, they are also protected under the *Migratory Birds Convention Act, 1994*.

Mink

The mink was selected as the VEC to represent all other semi-aquatic mammals due to its sensitivity to contaminants and potential presence in Ned's Pond, Pond #2 and surrounding habitat. Minks are valuable to humans primarily for their pelts which are used in the manufacture of fur coats and other attire.

Other Receptors

Osprey and Bald Eagles have very large habitat ranges and if present would be considered transient. These species are not expected to be present at Ned's Pond, Pond #2 or the on-site marsh for substantial portions of their lifespans. Therefore, they are not considered VECs for the purpose of this study.

Although potentially present in the water and sediment of Ned's Pond, Pond #2 and/or the on-site marsh, reptiles and amphibians were not considered as VECs. The only species identified as potentially present was the American Toad, a species which is not considered rare or endangered (Atlantic Canada Conservation Data Centre, 2002). In addition, this amphibian spends a large portion of its lifespan on land and would therefore not be continually exposed to any POCs in the sediment

and/or surface water of Ned's Pond, Pond #2, and/or the on-site marsh. Thus, benthic infauna was considered to be a more sensitive receptor due to it continual exposure to sediment and the overlying surface water.

In addition, other mammals, such as the beaver, muskrat, and otter were also not considered VECs for the purpose of this study. Instead, the mink was selected as the most sensitive species which would serve as a surrogate for other semi-aquatic mammals present in Ned's Pond, Pond #2, and the surrounding area.

### 3.1.2 Conceptual Model of Exposure

For the VECs identified above, the following outlines the conceptual model for exposure. A conceptual model is a representation of how the hazards can reach the identified receptors.

Benthic Infauna:

Benthic infauna may be exposed to POCs in the sediment and overlying surface water in Ned's Pond, Pond #2 or the on-site marsh through direct contact and also through incidental ingestion of water and sediment during feeding. Larger infauna may also be exposed to POCs via ingestion of smaller infauna which have been directly exposed.

Brook Trout:

Brook trout may be exposed to POCs in the sediment and/or overlying surface water of Ned's Pond or Pond #2 through direct contact and also through incidental ingestion of water and sediment during feeding. They may also be exposed to POCs via ingestion of other organisms which have accumulated certain chemicals, therefore bioaccumulation may occur. No fish are expected to be present in the on-site marsh due to the limited overlying surface water which would not provide suitable habitat for fish.

Black Ducks:

Black Ducks may be exposed to POCs in the sediment and/or overlying surface water of Ned's Pond or Pond #2 through direct contact and also through incidental ingestion of water and sediment during feeding. In addition, black ducks may be exposed to POCs in the sediment of the on-site marsh while feeding. Since their diet consists of plants (i.e. seeds, aquatic plants, wild berries, grains), small molluscs, amphipods, and other invertebrates) (Environment Canada, 1998), black ducks may also be exposed to POCs via ingestion of other small organisms which have accumulated certain chemicals, therefore bioaccumulation may occur.

Mink:

Mink may be exposed to the POCs in the sediment and overlying surface water of Ned's Pond or Pond #2 during swimming or feeding in the ponds. In addition, mink may be exposed to POCs in the sediment of the on-site marsh while foraging for food. Since fish and invertebrates constitute a large portion of the mink's diet, they may be exposed to contaminants through the ingestion of benthic infauna in Ned's Pond, Pond #2 and/or the on-site marsh, and fish from Ned's Pond and/or Pond #2.

## 3.2 Objectives of ERA

The main objective of this risk assessment is to determine the magnitude of risk to non-human receptors to ensure there are no elevated adverse effects to aquatic or terrestrial VECs (i.e. decreased size, weight, increased mortality) due to contaminants in the sediment or surface water of Ned's Pond, Pond #2 and/or the on-site marsh.

## 3.3 Assessment and Measurement Endpoints

The objectives of the ERA are typically very large in scope and need to be translated into assessment endpoints that can accomplish the ERA goals, are relevant to the hazard and can be defined and assessed. Assessment endpoints, however, are not generally measurable, in the practical sense, and need to be translated into measurement endpoints. Measurement endpoints are measurable environmental characteristics that are related to the assessment endpoint. Table 3.2 presents the applicable assessment and measurement endpoint for this risk assessment.

**Table 3.2: Determination of Assessment and Measurement Endpoints**

| Site Problem | ERA Objective | Assessment Endpoint | Indicator of Effects | Measurement Endpoints |
|---|---|---|---|---|
| Waste material buried in soil at UAS leaches to soil and further leaches to groundwater, groundwater discharges to Ned's Pond, Pond #2 or the on-site marsh; or impacts in surface soil migrate to surface water bodies through surface runoff. | No elevated adverse effects to VECs (i.e. decreased size, weight or increased mortality) | No more than 10% reduction in VEC populations | Laboratory or field toxicity to fish, food chain organisms | Compare sediment and surface water parameter concentrations to acceptable screening criteria (i.e. CCME, 2001) which are intended to be protective of aquatic life. Conduct toxicity testing using amphipods and bacterium to determine sediment toxicity. Analyse fish samples from Ned's Pond and Pond #2 for impacts and compare to fish concentrations to applicable guidelines (CCME, 2001) and to concentrations from the reference areas. Based on toxicity testing and contaminant concentrations in fish, compare these to toxicity values for birds and small mammals (such as the black duck and mink). |

## 3.4 Exposure Assessment

### 3.4.1 Target Parameter Selection

The target parameters for this ERA are based on the most recent extensive sampling program conducted by Environment Canada in November and December, 2001. This is the most recent data available and it is the most extensive sampling program conducted in the ponds and on-site marsh to date. In addition, a rigorous QA/QC program was implemented, including the submission of samples to more than one laboratory and the collection of sediment, surface water and fish samples from more than one reference location. As such, the data from this sampling program will be used in this RA, with less attention to previous data.

For example, all recent sediment sample data contained non-detectable concentrations of PCBs, including samples collected at a similar location to Sample SED-P#2 (ADI, 1998). Due to the inconsistencies between the most recent data and the one previous sample, the previous sample is not considered representative of typical site PCB concentrations and has therefore not been used in this risk assessment.

The site sediment, surface water and fish carcass and tissue parameters which exceeded the reference areas maximum concentrations and (where assessed, i.e. sediment and surface water) were significantly different from the reference areas are presented in Table 3.3. In addition, the 95$^{th}$ percentile upper confidence limit (UCL) on the arithmetic mean was calculated for each parameter from Ned's Pond, Pond #2 and the on-site marsh which exceeded the reference area. All samples from these three areas were used in deriving the 95$^{th}$ UCL, assuming exposure to all sediment in the three areas would be similar. The UCL is used to assign probabilities to the size of sampling error. Confidence limits are used to describe a range within which a true value lies within a stated probability. For example, a 95% UCL on the mean value represents the upper bound of a range that has a 95% chance of including the actual mean concentration for a dataset. This approach is based on USEPA

(1989) which states that the expected exposure concentration should be the arithmetic average of the identified concentrations. Because of uncertainty associated with any estimate of the exposure concentration, it is recommended that the upper confidence limit on the estimate of the arithmetic mean be used as the expected exposure concentration (USEPA, 1989).

The maximum concentration and the 95% UCL were compared to generic screening criteria (where available). Only those parameters with a 95% UCL which exceeded the screening and background concentrations (or background concentrations only where no screening criteria exist) and were significantly different from the reference areas have been carried forward in the risk assessment for benthic infauna and brook trout.

For black ducks and mink, the CCME (2001) sediment and surface water criteria are not applicable, as these criteria apply only to aquatic receptors. The CCME (2001) tissue residue guidelines apply to consumers of aquatic biota, which would include black ducks and mink, however, the only applicable guideline is for methylmercury. Thus, any contaminant which exceeded the background concentration and was significantly different from the reference areas was carried forward in the assessment of potential risk to black ducks and mink.

**Table 3.3: Site Sediment, Surface Water and Fish Concentrations (Exceeding Reference Areas) In Comparison to Generic Screening Criteria**

| Location | Parameter Exceeding Background | Criteria | Maximum Concentration | 95th UCL on the Mean Concentration* | Exceeds Screening (if applicable) and Carried Forward? | |
|---|---|---|---|---|---|---|
| | | | | | Benthos, Brook trout | Black ducks &/or Mink |
| **SEDIMENT (mg/kg)** | | | | | | |
| Ned's Pond | Toluene | No criteria | 0.06 | n/c - one detected sample | Yes | Yes |
| | Xylenes | No criteria | 0.12 | n/c - one detected sample | Yes | Yes |
| | Lead | 35 (CCME ISQG, 2001) | 59.1 | 38 | Yes | Yes |
| Pond #2 | Lead | 35 (CCME ISQG, 2001) | 34.4 | 38 | No | Yes |
| On-site Marsh | Lead | 35 (CCME ISQG, 2001) | 43 | 38 | Yes | Yes |
| **SURFACE WATER (ug/L)** | | | | | | |
| Ned's Pond | Aluminum | 5-100 (CCME, 2001) | 99.0 | 96 | No | Yes |
| | Barium | 1000 (GCDWQ, 2001) | 16 | 19 | No | Yes |
| | Strontium | 22000 (USEPA, 2001a) | 44 | 59 | No | Yes |
| Pond #2 | Aluminum | 5-100 (CCME, 2001) | 105 | 96 | No | Yes |
| | Barium | 1000 (GCDWQ, 2001) | 29 | 19 | No | Yes |
| | Strontium | 22000 (USEPA, 2001a) | 94 | 59 | No | Yes |
| **FISH CARCASS AND TISSUE (mg/kg)** **(For the contaminants where the mean concentration in the carcass or fillet exceeded the reference area)** | | | | | | |
| Ned's Pond | Acenaphthene | No fish carcass/tissue criteria | 0.01 (carcass) | n/c | Yes | |
| | Barium | No fish carcass/tissue criteria | 0.06 (fillet) | 0.065 (mean conc.) | Yes | |
| | Cadmium | No fish carcass/tissue criteria | 0.005 (fillet) | 0.005 (mean conc.) | Yes | |
| | Copper | No fish carcass/tissue criteria | 1.84 (carcass) | 0.914 (mean conc.) | Yes | |
| | Mercury | 0.033 mg/kg fish tissue (wet weight) (CCME, 2001) | 0.059 (carcass) 0.091 (fillet) | 0.0364 (mean conc.) | Yes Yes | |
| | Vanadium | No fish carcass/tissue criteria | 0.09 (carcass) | 0.09 (mean conc.) | Yes | |
| Pond #2 | Acenaphthene | No fish carcass/tissue | not detected | n/c | No | |

**Table 3.3: Site Sediment, Surface Water and Fish Concentrations (Exceeding Reference Areas) In Comparison to Generic Screening Criteria**

| Location | Parameter Exceeding Background | Criteria | Maximum Concentration | 95th UCL on the Mean Concentration* | Exceeds Screening (if applicable) and Carried Forward? | |
|---|---|---|---|---|---|---|
| | | | | | Benthos, Brook trout | Black ducks &/or Mink |
| | | criteria | | | | |
| | Barium | No fish carcass/tissue criteria | 0.04 (fillet) | 0.065 (mean conc.) | No (same as reference area) | |
| | Cadmium | No fish carcass/tissue criteria | not detected | 0.005 (mean conc.) | No | |
| | Copper | No fish carcass/tissue criteria | 0.68 (carcass) | 0.914 (mean conc.) | No (lower than reference area) | |
| | Mercury | 0.033 mg/kg fish tissue (wet weight) (CCME, 2001) | 0.023 (carcass) 0.0367 (fillet) | 0.0364 (mean conc.) | No | Yes |
| | Vanadium | No fish carcass/tissue criteria | not detected | 0.09 (mean conc.) | No | |

Notes:
GCDWQ refers to the Guidelines for Canadian Drinking Water Quality (2001) - these criteria were used in the to screen substances in absence of other non-human surface water criteria (i.e. CCME, 2001)
*95th Upper Confidence Limit was calculated on the mean of all samples which exceeded the reference area concentrations (both sediment and surface water) - see Appendix D for equations.
n/c - not calculated - if maximum site concentration (from either Ned's Pond, Pond #2 or the on-site marsh) did not exceed the maximum reference area concentration, no UCL was calculated for sediment or surface water; for fish, no 95th UCL was calculated, and contaminants were screened on the basis of whether the mean concentration on-site exceeded the mean concentration from the reference area

As presented in Table 3.3, where the 95th UCLs of the substances exceeded both background concentrations and the screening criteria (where available), these parameters were considered to be potential hazards to non-human receptors, and were further assessed in this risk assessment for benthic invertebrates and brook trout. In addition, the substances which exceeded the background concentrations but had no screening criteria, were also further assessed in this risk assessment for benthic invertebrates and brook trout. For benthic invertebrates, black ducks and mink, sediment concentrations from Ned's Pond, Pond #2 and the on-site marsh were considered for potential exposure.

### 3.4.2 Exposure Assessment for VECs

The key pathways leading to the potential exposure of VECs to the identified hazards are presented in Table 3.3 and include direct contact and/or ingestion of sediment and/or surface water and/or ingestion of impacted biota (including benthic invertebrates and fish).

#### 3.4.2.1 Benthic Infauna and Brook Trout Exposure to Sediment

Due to the presence of POC concentrations in the sediment which exceeded the applicable screening criteria and/or background concentrations in one or more locations in Ned's Pond, Pond #2, and/or the on-site marsh, as presented in Table 3.3, it was necessary to compare these concentrations to literature-based ecotoxicity values to determine the potential for adverse effects to benthic infauna and/or brook trout from exposure to POCs in the sediment. For benthic infauna and brook trout, no POCs were identified in the surface water, therefore, no surface water parameters have been assessed for these organisms. Benthic infauna health was of concern for Ned's Pond, Pond #2 and the on-site marsh. Due to the lack of water in the on-site marsh, brook trout were not expected to be present, therefore brook trout health was of concern for Ned's Pond and Pond #2 only.

Toxicity testing of sediments collected from Ned's Pond, Pond #2 and the on-site marsh in November and December, 2001, indicated no elevated mortality or decreased weight to amphipods and no elevated decrease in bioluminescence for test bacterium in comparison to the reference areas or lab controls.

The toxicity testing was conducted on sediment samples from Stations 1, 3, and 5 of Ned's Pond, Pond #2, Black Duck Pond and Control Pond 2, and on two sediment samples from the on-site marsh and the reference marsh. The sediment in Ned's Pond, Pond #2 and/or the on-site marsh contained detectable concentrations of toluene and xylenes (in excess of the reference area), and lead were identified (based on the 95$^{th}$ UCL) in excess of the background concentrations and applicable screening criteria (where available). Therefore, although the sediment in Ned's Pond, Pond #2 and/or the on-site marsh may contain elevated concentrations of certain metals in excess of CCME (2001) ISQG or PEL, these concentrations do not appear to be adversely affecting the health of benthic infauna, based on the 14 day amphipod growth and survival test and the 30 minute Microtox test results.

Fish tissues (carcasses and fillets) collected from Ned's Pond and Pond #2 contained traces of several PAHs and metals. As presented in Table 3.4, all POCs identified in the fish carcasses and fillets are within the typical range of metals concentrations in fish from other areas as identified in scientific literature (Canadian data where available).

**Table 3.4 Average POC Concentrations in Fish (From Literature)**

| Parameter | Highest Conc. in Ned's Pond and/or Pond #2 (mg/kg) | Average Concentration in Fish From Literature (mg/kg) |
|---|---|---|
| Acenaphthene | 0.01 (carcass)<br>nd (fillet) | 0.039 - Bullhead catfish (Ohio) (HSDB, 2002)<br>0.007 - Striped bass (Maryland) (HSDB, 2002) |
| Barium | 0.47 (carcass)<br>0.08 (fillet) | 22 - sculpin maximum concentration (Oregon) (USGS, 1999)<br>10 - sculpin median concentration (Oregon) (USGS, 1999) |
| Cadmium | 0.016 (carcass)<br>0.005 (fillet) | 0.1-0.3 - fish from uncontaminated areas (whole body dry wt) (HSDB, 2002)<br>0.0009 - lake trout (Colville Lake, NWT) (Environment Canada, 1996b)<br>0.01 -lake trout (Quebec) (Environment Canada, 1996b) |
| Copper | 1.84 (carcass)<br>0.44 (fillet) | 3.8 - sculpin maximum concentration (Oregon) (USGS, 1999)<br>2.8 - sculpin median concentration (Oregon) (USGS, 1999)<br>1.21 - lake trout (Colville Lake, NWT) (Environment Canada, 1996b)<br>0.35 - (Quebec) (Environment Canada, 1996b) |
| Mercury | 0.059 (carcass)<br>0.091 (fillet) | 0.3 - resident fish (USEPA, 1999a)<br>0.29 - edible fish (USEPA, 1999a)<br>0.28 - lake trout (Colville Lake, NWT) (Environment Canada, 1996b)<br>0.71 - lake trout (Health Canada, 1996)<br>0.38 - lake trout, northern pike, walleye mean value (range between 0.01-13) (Health Canada, 1996) |
| Vanadium | 0.09 (carcass)<br>nd (fillet) | 4.74 - lake trout (HSDB, 2002)<br>3.88 - pike (HSDB, 2002)<br>6.43 - white sucker (Cold Lake, AB) (HSDB, 2002)<br>0.075 - burbot (HSDB, 2002)<br>0.26 - bloater chub (Lake Huron) (HSDB, 2002) |

Literature-Based Toxicity Values

Each sediment sample collected from Ned's Pond and Pond #2 corresponded to a surface water sample collected in the same location. For the on-site marsh, however, no surface water samples were collected in November/December 2001 (due to the lack of standing water present).

In order to compare the POC concentrations in the on-site marsh sediment with ecotoxicity values which are based on exposure to POCs in water, it was necessary have an overlying surface water concentration representative of the POCs partitioning from the sediment. For Ned's Pond and Pond #2, the corresponding surface water samples were compared, however, it was necessary to predict overlying surface water concentrations in the on-site marsh. This was done by using the following equations:

$$C_{oc} = K_p C_d$$

and

$$K_p = f_{oc} K_{oc} \text{ (USEPA, 2000)}$$

Where:

$C_{oc}$ = sediment concentration (mg/kg);
$K_p$ = partition coefficient between pore water and sediment solids; normalized with respect to organic content of sediment (L/kg).
$C_d$ = pore water concentration (mg/L);
$f_{oc}$ = fraction of organic carbon (%); and
$K_{oc}$ = partition coefficient between pore water and sediment solids (L/kg).

In order to derive Cd concentration from Coc concentration- the equation would be written as follows:

$$C_d = C_{oc} / K_p$$

The equation was applicable to metals, because the partition coefficients were normalized based on the organic content of the sediment (USEPA, 2000). For the fraction of organic carbon value, the mean foc value from Ned's Pond and Pond #2 was used. Where $K_p$ values were available (USEPA, 1999b), these values were used instead of the calculated values using the $K_{oc}$.

The equations are presented in Table D.1 in Appendix D, and the results are as follows:

**Table 3.5: Predicted Sediment Pore Water POC Concentrations - On-site Marsh**

| POC | Max. Sediment Concentration - On-site Marsh (Coc) (mg/kg) | Kp* (L/kg) | Predicted Sediment Pore Water Concentration - On-site Marsh (Cpw) (mg/L) |
|---|---|---|---|
| Lead | 43 | 9.00E+02 | 4.78E-02 |

Table 3.6 presents the POCs in the sediment that exceeded generic criteria (based on the 95% UCL) and/or background concentrations (significantly different from the reference areas), provides a brief description of typical sources for these substances, identifies the highest sediment concentration in Ned's Pond, Pond #2, and the on-site marsh, presents the corresponding or predicted (for the on-site marsh - from Table 3.5) surface water sample for the highest sediment sample, and provides ecotoxicological data for invertebrates, freshwater fish, and where possible, brook trout.

**Table 3.6: Sediment POCs and Relevant Ecotoxicity Information**

| Parameter | Typical Source (HSDB, 2002, except where specified) | Highest Sediment Conc. in Ned's Pond and/or Pond #2 | Highest Conc. in On-site Marsh Sediment | Correspond-ing Surface Water Sample in Ned's Pond and/or Pond #2 | Predicted Pore Water Conc. in On-site Marsh | Ecotoxicity Effects for Freshwater Species (from ECOTOX, 2002; and HSDB, 2002) |
|---|---|---|---|---|---|---|
| Toluene | Toluene is released into the atmosphere principally from the volatilization of petroleum fuels and toluene-based solvents and thinners and from motor vehicle exhaust | 0.06 mg/kg | n/a | Below detection limit | n/a | 35.5 mg/L - LC100 - Rainbow trout (48 hour renewal bioassay)<br>5.8-6.7 mg/L - LC50 - Rainbow trout (96 hour flow-through bioassay)<br>8 mg/L - NOAEL - Rainbow trout (96 hour static bioassay) |
| Xylenes | Its production and use in petroleum products, as a chemical solvent, and as an organic synthesis reagent. May be released to the environment through discharges from storage facilities and the use of automobiles. Natural sources of xylene include petroleum, forest fires and the volatiles of plants. | 0.075 mg/kg | n/a | Below detection limit | n/a | 16.1 mg/L - LC100 - Rainbow trout (2 hour flow-through bioassay)<br>2.661-4.093 mg/L - LC50 - Rainbow trout (96 hour static bioassay)<br>7.1 mg/L - LC0 (Lethal concentration to none of the test organisms) - Rainbow trout (2 hour flow-through bioassay) |
| Lead | It may enter the environment during its mining, ore processing, smelting, refining, manufacture of lead compounds, use of lead metals, alloys and compounds in products like batteries and paints, recycling, and disposal. A former major source of exposure to lead was from the use of tetraethyl lead as an antiknock agent in gasoline | 59 mg/kg | 43 mg/kg | 0.0012 mg/L | 4.78e-02 mg/L | 3.6-5.3 mg/L - LC50 - *Daphnia magna* (48 hour static bioassay)<br>1.47 mg/L - LC50 - Rainbow trout (96 hour static bioassay)<br>0.0076 mg/L - LC50 - Rainbow trout (19 month flow-through bioassay)<br>1.19 mg/L - LOEC - Rainbow trout (96 hour flow-through bioassay)<br>0.0072 mg/L - NOEC (no observed effect concentration - Rainbow trout (19 month flow-through bioassay)<br>0.5 mg/L - adverse effects to freshwater algae (conditions not specified) |
| Notes: n/a - not applicable because it was not carried forward as a POC | | | | | | |

Based on Table 3.6, with the exception of lead, the POCs in sediment that were modeled to predict overlying surface water concentrations are typically an order of magnitude lower than the relevant ecotoxicological value.

Although the predicted lead concentration in the on-site marsh was higher than the 19 month flow-through bioassay for Rainbow trout (ECOTOX, 2002), due to the limited surface water present, the on-site marsh is not considered fish habitat. No unacceptable risks were identified in the on-site marsh for *Daphnia magna* or freshwater algae, species which are more likely to be present in the marsh. Therefore, lead has not been further assessed as a POC in surface water in the on-site marsh to benthic infauna.

Therefore, based on the sediment POC concentrations and the actual or predicted overlying surface water POC concentrations, the current POCs are not expected to pose unacceptable risks to benthic infauna or fish inhabiting Ned's Pond and/or Pond #2 or on benthic infauna present in the on-site marsh.

Fish were collected from Ned's Pond, Pond #2, Black Duck Pond and Control Pond 2 as part of this study and were analysed for the same parameters as the sediment and surface water (except for BTEX/TPH). As presented in Table 3.3, acenaphthene and several metals (barium, cadmium, copper, mercury, and vanadium) were identified in the tissue and/or carcasses of the fish collected from Ned's Pond and/or Pond #2 which exceeded the concentrations in fish from the reference areas. As indicated in Table 3.4, the POC concentrations identified in the fish collected from Ned's Pond and Pond #2 are either similar to or below the average literature-based POC concentrations for fish collected from sites near areas of human occupation (i.e. not from largely uninhabited areas such as in the Canadian Northwest Territories). Thus, the fish from Ned's Pond and Pond #2 do not appear to be more impacted than fish from other similar locations in Canada and/or the U.S.

#### 3.4.2.2 Black Duck Exposure to Sediment, Surface Water and Benthic Infauna

Black ducks may be exposed to contaminants in Ned's Pond, Pond #2 and/or the on-site marsh through incidental ingestion of sediment, dermal contact and ingestion of surface water (Ned's Pond and/or Pond #2), and/or through the ingestion of benthic infauna.

In a comparison of contaminant concentrations in surface water from samples collected at Ned's Pond, Pond #2 and the reference areas of Black Duck Pond and Control Pond 2 the following contaminants (as presented in Table 3.3) were higher in Ned's Pond and/or Pond #2 in comparison to the reference areas and considered POCs to black ducks and mink: aluminum; barium; and strontium. Although these substances were screened out in previous sections based on a comparison to generic screening criteria, these criteria (CCME, 2001) are applicable only for the protection of aquatic life, which do not include birds or mammals (such as the black duck or the mink).

In a comparison of contaminant concentrations in sediment from samples collected at Ned's Pond, Pond #2, the on-site marsh, and the reference areas of Black Duck Pond, Control Pond 2 and the reference marsh, the following contaminants (as presented in Table 3.3) were higher in Ned's Pond, Pond #2 and/or the on-site marsh in comparison to the reference areas: toluene, xylenes, and lead.

Dermal Exposure to Surface Water and Sediment

Exposure by black ducks to surface water through dermal contact is expected to be much lower than through direct ingestion due to the relative impermeability of their down. Although dermal exposure may occur during preening, ingestion is expected to be a more relevant pathway. In addition, the identified contaminants tend to be very poorly sorbed through skin (USEPA, 2001b), which would also act to limit exposure. Thus, given the water resistant plumage and the limited sorption potential of the identified surface water contaminants through skin, no unacceptable risks are expected to black ducks through dermal contact exposure to the surface water of Ned's Pond and/or Pond #2.

Exposure by black ducks to sediment through dermal contact is expected to be much lower than through direct ingestion due to the limited exposure duration. Since ducks inhabit the surface water, dermal exposure to sediment is expected to be limited to occasions when feeding on invertebrates inhabiting the sediment. In addition, the majority of the identified contaminants tend to be very poorly sorbed through skin and/or have limited persistence (USEPA, 2001b; HSDB, 2002), which would also act to limit exposure. Thus, given the limited exposure duration and limited sorption potential or persistence of the identified contaminants in the sediment, no unacceptable risks are expected to black ducks through dermal contact exposure to the sediment of Ned's Pond, Pond #2 and/or the on-site marsh.

Ingestion Exposure to Surface Water, Sediment and Benthic Infauna

A total daily exposure rate for black duck ingestion of surface water, sediment and benthic infauna was calculated based on the identified POCs in the surface water and sediment. The calculations are presented in Appendix D.

For surface water ingestion exposure, the 95$^{th}$ % UCL concentration on the mean of all samples collected from Ned's Pond and Pond #2 were used to calculate the average daily intake of POCs in surface water for black ducks. A water ingestion rate of 0.08 L/day (Sample et. al., 1996) and a body weight of 0.782 kg (based on mallard ducklings [*Anas platyrhynchos*]) (Cain and Pafford, 1981) were used in the calculation of average daily POC intake in mg/day. It was assumed that all water ingested by black ducks would be from Ned's Pond and/or Pond #2.

For sediment ingestion exposure, the 95$^{th}$ % UCL concentration on the mean of all samples collected from Ned's Pond, Pond #2 and the on-site marsh were used to calculate the average daily intake of POCs in sediment for black ducks. A sediment ingestion rate of 3.3% of the total food intake (dry weight) (Beyer et. al., 1994) and a total food intake value of 0.0782 kg/day for mallard ducklings (Heinz et. al., 1989) were used in the calculation of average daily POC intake in mg/day. It was assumed that all sediment ingested by black ducks would be from Ned's Pond, Pond #2 and/or the on-site marsh.

For benthic infauna ingestion exposure, benthic infauna POC concentrations were calculated using the sediment concentration, the average total organic carbon (TOC) content of the sediment, the sediment-to-biota accumulation factor (BSAF) (Sample et. al., 1996), and the lipid content of the benthic organisms (Cantox, 1996). The equation is as follows:

$$\text{Invertebrate concentration} = \frac{\text{sediment concentration}}{\text{organic carbon content}} * \text{BSAF} * \text{lipid content}$$

The BSAF values are presented in Table 3.7, below. The BSAF is the ratio of the steady state concentration of a substance in an organism due to uptake via contact with sediment. According to the CEPA Persistence and Bioaccumulation Regulations (Government of Canada, 2000), a substance is considered bioaccumulative if it has a BSAF greater than or equal to 5000. Since the contaminants available for exposure by benthic infauna would be primarily in the sediment, Table 3.7 presents the published BSAFs for each of the POCs identified in the sediment of Ned's Pond, Pond #2 and/or the

on-site marsh which exceeded the applicable screening criteria and/or reference area concentrations (USEPA, 1999c). Calculations for those BSAFs derived from the Kow (octanol water partition coefficient) values are presented in Table D.2 in Appendix D. Calculations for predicted benthic infauna POC concentrations based on sediment POC concentrations are presented in Table D.3 in Appendix D.

**Table 3.7: BSAFs for Sediment POCs**

| POC | Study Organism | BSAF |
|---|---|---|
| Toluene | Calculated based on Kow | 10.93 |
| Xylenes | Calculated based on Kow | 26.17 |
| Lead | Midge | 0.63 |
| The equation for calculating BSAFs from octanol-water partition coefficients is as follows:<br>Log BSAF = 0.819 x log Kow - 1.146 (Source: USEPA, 1999c)<br>All BSAFs were either calculated or presented in USEPA (1999c) and/or USEPA (1999d) | | |

As presented in Table 3.7, the measured or calculated BSAFs are lower than the CEPA benchmark of 5000. Therefore, the POCs identified in Ned's Pond, Pond #2, and/or the on-site marsh are expected to have a low bioaccumulation potential in benthic infauna.

The predicted benthic infauna POC concentrations were then multiplied by the average food daily intake amount (assumed to be the total food intake [0.0782 kg/day] less the total sediment ingestion intake [[3.3% or 2.58e-03 kg/day], or 96.7% [7.56e-02 kg/day]) to derive an average daily POC intake in mg/day. It was assumed that all benthic infauna ingested by black ducks would be from Ned's Pond, Pond #2 and/or the on-site marsh.

For total daily exposure to POCs in the sediment, surface water and benthic infauna, each of the three calculated intake concentrations (in mg/day) were summed. These total values have been compared to applicable toxicity benchmarks for ducks. Table 3.8 presents the average daily intake rates of sediment, surface water and benthic infauna, in comparison to the toxicity benchmarks for black ducks (where available), mallard ducks and/or other birds based on availability of toxicity data. Where a substance was not considered a POC for the specific media, an average daily intake value was derived based on the 95$^{th}$ % UCL on the mean of all samples collected from Ned's Pond, Pond #2 and (for sediment only) the on-site marsh. This was conducted in order to assess for potential cumulative effects, irrespective as to whether the substance was considered to be a potential hazard in any one particular medium. The applicable equations for black duck exposure to surface water, sediment and benthic infauna ingestion are presented in Tables D4-D7 in Appendix D.

**Table 3.8: Average Black Duck Daily Contaminant Intake from Surface Water, Sediment and Benthic Infauna Ingestion (mg/kg bw/day)**

| Parameter | Average Daily POC Intake from Water Ingestion | Average Daily POC Intake from Sediment Ingestion | Average Daily POC Intake from Food Ingestion (Benthic Infauna) | Average Daily POC Intake From Water, Sediment and Benthic Infauna | Average Daily Adult Duck POC Intake (assuming 1 kg body weight) (Heniz et. Al., 1989) | Average Daily Duckling POC Intake (assuming 0.782 kg body weight) (Heinz et. al., 1989) | Toxicity Benchmarks (mg/kg-bw/day) (Sample et. al., 1996) | |
|---|---|---|---|---|---|---|---|---|
| | mg/day | mg/day | mg/day | mg/day | mg/kg-bw/day | mg/kg-bw/day | NOAEL | LOAEL |
| Aluminum | 8.01E-03 | 1.01E+02 | 5.90E+02 | 1.60E+02 | 1.60E+02 | 1.25E+02 | 109.7 ($Al_2(SO_4)_2$) | none for $Al_2(SO_4)_2$ (see below) |
| Barium | 1.58E-03 | 6.45E-01 | 1.13E+00 | 1.78E+00 | 1.78E+00 | 1.39E+00 | 20.8 (barium hydroxide) | 41.7 (barium hydroxide) |
| Lead | 2.59E-04 | 9.81E-02 | 1.21E-01 | 2.19E-01 | 2.19E-01 | 1.71E-01 | 1.13 (lead acetate | 11.3 (lead acetate) |
| Strontium | 4.92E-03 | 2.48E-01 | 4.36E-01 | 6.88E-01 | 6.88E-01 | 5.38E-01 | See below | |
| Toluene | nd | 1.55E-04 | 4.84E-06 | 1.60E-04 | 1.60E-04 | 1.25E-04 | See below | |
| Xylenes | nd | 3.10E-04 | 9.07E-05 | 4.00E-04 | 4.00E-04 | 3.13E-04 | See below | |
| Notes:<br>n/a = not available | | | | | | | | |

Aluminum

Although the predicted daily intake of aluminum exceeded the NOAEL, there was no LOAEL for $AL_2(SO_4)_2$. One aluminum study involving birds was an ingestion study where 1400 mg/kg aluminum ingested by chickens caused a lower level of inorganic phosphorus in the blood and bones, with the development of severe rickets (Browning, 1969). According to the Handbook on the Toxicity of Inorganic Compounds, aluminum is only sparingly absorbed by the gut, and $LD_{50}$ values for aluminum ingestion are unavailable since mortality occurs from intestinal blockage due to precipitated aluminum rather than through systemic aluminum toxicity (Seiler et. al., 1988). Thus no unacceptable risks are expected to black ducks based on the predicted maximum expected daily intake concentration.

Strontium

Although no study of the effects of strontium exposure to ducks was identified, a study of strontium exposure to quail hens was conducted by Quintana et. al. (1980). The concentration fed to hens which resulted in abnormalities to the unhatched eggshells was several orders of magnitude higher than potential exposure from the site via surface water ingestion. In addition, the concentration fed to hens was lower than the applicable acute toxicity value (lethal dose wherein 50% of the population dies - the $LD_{50}$) as the survival rate of the hens was not an issue in this experiment. Based on the maximum concentration identified, strontium in the surface water of Ned's Pond and Pond #2 is not expected to cause adverse effects to black ducks via ingestion exposure.

Toluene

One study involving toluene exposure to fertile chicken eggs via injection into the yolk sac prior to incubation. Hatchability of the eggs were 95%, 25% and 0% with exposure of 4.3, 8.7 and 17.4 mg/egg, respectively (HSDB, 2002). Toluene is not expected to sorb strongly onto suspended solids and/or sediment. At low concentrations, it is expected to dissolve into overlying surface water. It rapidly degrades in water, with a reported half-life of 4 days in aerobic and 56 days in anaerobic waters (HSDB, 2002). Therefore, toluene, which was identified in one sample from Ned's Pond only, is not expected to be persistent and exposure by black ducks is expected to be minimal. In addition, the predicted daily intake of toluene is below the standard analytical detection limit of 0.025 mg/kg. Therefore, due to the limited exposure, the extremely low concentration identified in one location only, and the estimated half-life values for aquatic systems, no unacceptable risks are expected to black ducks through ingestion of toluene in sediment.

Xylenes

Two studies involving xylene exposure to birds were identified (HSDB, 2002). One study involved the immersion of mallard eggs in a 10% xylene solution for 30 seconds, with no increased effect on embryonic weight or length compared to the controls. The second study involved directly spraying quail eggs with 20,000 or 500 mg/L aqueous solution of xylene, or indirectly exposing eggs via repeated ingestion of the parental quail to contaminated feed. Xylene exposure reduced the hatching rate, embryonic viability, and increased the fecundation rate and weight of eggs, chicks, and adults. Xylene reversed the sex ratio so that male birds had an advantage in number and exposure acted more specifically on the embryonic genital development (HSDB, 2002). Xylenes may sorb to suspended solids and/or sediment. At low concentrations, it is expected to dissolve into overlying surface water. It will volatilize from water surfaces, with experimental half life values in a model river and model lake of 3 and 99 hours, respectively (HSDB, 2002). Therefore, xylenes, which were identified in one sample from Ned's Pond only, is not expected to be persistent and exposure by black ducks is expected to be minimal. In addition, the predicted daily intake of xylene is below the standard analytical detection limit of 0.025 mg/kg. Therefore, due to the limited exposure, the extremely low concentration identified in one location only, and the estimated half-life values for aquatic systems, no unacceptable risks are expected to black ducks through ingestion of xylene in sediment.

Based on the results in Table 3.8, and the related toxicity data pertaining to birds and aluminum, strontium, toluene and xylenes, the total daily intake from various media is lower than the applicable toxicity values for total daily exposure for ducks. Therefore, any contaminants in Ned's Pond, Pond #2, and/or the on-site marsh exceeding the reference area are not expected to pose an elevated risk to black ducks that may be exposed to contaminants in the surface water, sediment, or benthic infauna through ingestion exposure.

### 3.4.2.3 Mink Exposure to Sediment, Surface Water and Ingestion of Benthic Infauna and Fish

Mink may be exposed to contaminants in Ned's Pond, Pond #2 and/or the on-site marsh through incidental ingestion of sediment, dermal contact and ingestion of surface water (Ned's Pond and/or Pond #2), through the ingestion of benthic infauna, and/or the ingestion of fish (Ned's Pond and/or Pond #2).

The POCs in sediment and surface water for mink were the same as those for black ducks, which included aluminum, barium, and strontium in surface water; and toluene, xylenes, and lead in sediment. In addition, due to the potential for mink to consume fish, the POCs in fish were also of concern for exposure by mink and included acenaphthene, cadmium, copper, mercury and vanadium.

Dermal Exposure to Surface Water and Sediment

Exposure by mink to surface water through dermal contact is expected limited due to the relatively low dermal absorption rates of the identified contaminants (USEPA, 2001b). Low absorption rates indicate that limited concentrations of these contaminants can be absorbed through skin following exposure. In addition, mink are semi-aquatic mammals, and therefore inhabit both terrestrial and aquatic habitats. Exposure to surface water is thus limited to the time spent in aquatic habitats. Given the limited sorption potential and limited exposure duration, mink are not expected to be adversely affected by the contaminants identified in the surface water through dermal contact exposure.

Therefore, no unacceptable risks are expected to mink through exposure to the contaminants identified in the surface water of Ned's Pond and Pond #2 that exceed those in the reference areas.

Exposure by mink to sediment through dermal contact is expected limited due to the relatively low dermal absorption rates of the identified contaminants (USEPA, 2001b). Low absorption rates indicate that limited concentrations of these contaminants can be absorbed through skin following exposure. In addition, mink are semi-aquatic mammals, and therefore inhabit both terrestrial and aquatic habitats. Exposure to sediment is thus limited to the time spent in aquatic habitats. Given the limited sorption potential and limited exposure duration, mink are not expected to be adversely affected by the contaminants identified in the sediment through dermal contact exposure.

Ingestion Exposure to Surface Water, Sediment, Benthic Infauna and Fish

A total daily exposure rate for mink ingestion of surface water, sediment, benthic infauna and fish was calculated based on the identified POCs in the surface water, sediment (both for sediment ingestion and uptake to benthic infauna), and fish. The calculations are presented in Appendix D.

For surface water ingestion exposure, the 95$^{th}$ % UCL concentration on the mean of all samples collected from Ned's Pond and Pond #2 were used to calculate the average daily intake of POCs in surface water for mink. A water ingestion rate of 0.099 L/day (Sample et. al., 1996) and a body weight of 1.0 kg (Sample and Suter, 1994) were used in the calculation of average daily POC intake in mg/day. It was assumed that all water ingested by mink would be from Ned's Pond and/or Pond #2.

For sediment ingestion exposure, the 95$^{th}$ UCL concentration on the mean of all samples collected from Ned's Pond, Pond #2 and the on-site marsh were used to calculated the average daily intake of POCs in sediment for mink. Due to a lack of data regarding daily sediment ingestion rates for mink, it was conservatively assumed that 3.3% of the total diet would be comprised of sediment (the same as for black ducks).

For benthic infauna ingestion exposure, benthic infauna POC concentrations were calculated using the sediment concentration, average sediment TOC content, the sediment-to-biota accumulation factor (BSAF) (Sample et. al., 1996), and the lipid content of the benthic infauna (Cantox, 1996). The equation is the same as used for black ducks in Section 3.4.2.2 of this report. In addition, the BSAFs calculated for black duck exposure to benthic infauna as presented in Table 3.7, are the same as those used in calculation mink exposure to POCs in benthic infauna.

The predicted benthic infauna POC concentrations were then multiplied by the average mink daily intake of benthic infauna (25% of total diet [Selander, 1943]), assuming an average daily food intake value of 0.137 kg/day (Sample et. al., 1996), for a total benthic infauna intake of 3.43e-02 kg/day.

For fish ingestion exposure, the mean POC concentration identified in fish from Ned's Pond and Pond #2 were used to calculated the average daily intake of POCs in fish for mink. The mean concentration was used in order to account for variations in fish size and lipid content. A fish ingestion rate of 44% of the total food intake (Selander, 1943) and a total food intake value of 0.137 kg/day (Sample, et. al., 1996) were used in the calculation of average daily POC intake in mg/day, for a total fish intake of 0.06 kg/day.

For total daily exposure to POCs in the sediment, surface water, benthic infauna and fish, each of the calculated intake concentrations (in mg/day) were summed. These total values have been compared to applicable toxicity benchmarks for mink. Table 3.9 presents the average daily intake rates and applicable toxicity benchmarks for mink based on Sample, et. al. (1996). Where a substance was not considered a POC for the specific media, an average daily intake value was derived based on the 95$^{th}$ % UCL on the mean of all samples collected from Ned's Pond, Pond #2 and (for sediment only) the on-site marsh. This was conducted in order to assess for potential cumulative effects, irrespective as to whether the substance was considered to be a potential hazard in any one particular medium. The applicable equations for mink exposure to surface water, sediment, benthic infauna, and fish ingestion are presented in Tables D8-D12 in Appendix D.

**Table 3.9: Average Mink Daily Contaminant Intake from Surface Water, Sediment, Benthic Infauna and Fish Ingestion (mg/kg bw/day)**

| Parameter | Average Daily POC Intake from Water Ingestion mg/day | Average Daily POC Intake from Sediment Ingestion mg/day | Average Daily POC Intake from Benthic Infauna mg/day | Average Daily POC Intake from Fish Ingestion mg/day | Average Daily Contaminant Intake From Water, Sediment, Benthic Invertebrates and Fish mg/day | Mink Average Daily Intake - (Assuming 1 kg body weight) (Sample et. al., 1996) mg/kg-bw/day | Toxicity Benchmarks (Mink) mg/kg-bw/day (Sample, et. al., 1996) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | NOAEL | LOAEL |
| Acenaphthene | nd | 4.39E-05 | 7.09E-06 | 6.00E-04 | 6.51E-04 | 6.51E-04 | 0.42 (benzo(a)pyrene) | 4.16 (benzo(a)pyrene) |
| Aluminum (total) | 9.50E-03 | 1.76E+02 | 2.67E+01 | 2.06E-01 | 2.03E+02 | 2.03E+02 | 0.803 ($AlCl_3$) | 8.032 ($AlCl_3$) |
| Aluminum (available) | 9.50E-03 | 6.33E+01 | 9.59E+00 | 2.06E-01 | 7.31E+01 | 7.31E+01 | 0.803 ($AlCl_3$) (see below) | 8.032 ($AlCl_3$) (see below) |
| Barium | 1.88E-03 | 1.13E+00 | 5.14E-01 | 1.96E-02 | 1.67E+00 | 1.67E+00 | 4.1 (barium chloride) | 15.2 (barium hydroxide) |
| Cadmium | 9.70E-06 | 3.80E-03 | 6.52E-03 | 8.1E-04 | 1.11E-02 | 1.11E-02 | 0.742 (cadmium chloride) | 7.419 (cadmium chloride) |
| Copper | 1.98E-04 | 1.58E-01 | 2.40E-02 | 5.48E-02 | 2.37E-01 | 2.37E-01 | 11.7 (copper sulfate) | 15.4 (copper sulfate) |
| Lead | 3.07E-04 | 1.72E-01 | 5.47E-02 | 2.78E-03 | 2.30E-01 | 2.30E-01 | 6.15 (lead acetate) | 61.53 (lead acetate) |
| Strontium | 5.84E-03 | 4.34E-01 | 1.97E-01 | 1.39E-01 | 7.76E-01 | 7.76E-01 | 202 (stable strontium chloride) | none identified |
| Vanadium | 0.00E+00 | 3.93E-01 | 5.96E-02 | 5.40E-03 | 4.58E-01 | 4.58E-01 | 0.15 (sodium metavanadate) | 1.5 (sodium metavanadate) |
| Mercury | 9.90E-06 | 6.33E-04 | 1.53E-04 | 3.12E-03 | 3.92E-03 | 3.92E-03 | 0.015 (methyl mercury) | 0.025 (methyl mercury) |
| Toluene | 0.00E+00 | 2.71E-04 | 2.19E-06 | na | 2.73E-04 | 2.73E-04 | 10.8 | 108.2 |
| Xylenes | 0.00E+00 | 5.43E-04 | 4.11E-05 | na | 5.84E-04 | 5.84E-04 | 0.874 | 1.082 |

Notes: na = not applicable - these parameters were not tested for that particular media

Based on the results in Table 3.9, with the exception of aluminum, the total daily intake from various media is lower than the applicable toxicity values for total daily exposure for mink (in mg/kg body weight per day, assuming an average body weight of 1 kilogram).

For aluminum, both 'total' and 'available aluminum' daily intake concentrations were calculated. Available aluminum was calculated from the 95% UCL of all samples analysed by Philip Analytical Services (PAS) (a total of four samples; one from Ned's Pond, Pond #2 and two from the on-site marsh). As opposed to RPC and ECB lab, PAS analysed the sediment samples for available metals rather than total metals. Available metals are more representative of the metals available for exposure by mink in the sediment. Both the predicted daily exposure by mink to total aluminum and to available aluminum exceeded the published LOAEL (Sample et. al., 1996). However, the LOAEL was based on a chronic (3 generation) mouse study involving oral exposure to aluminum in water, with decreased growth rates identified in offspring in generations 2 and 3. There were no effects on the numbers of litters or the numbers of offspring per litter in this study. In addition, according to the *Handbook on the Toxicity of Inorganic Compounds*, aluminum is only sparingly absorbed by the gut, and $LD_{50}$ values for aluminum ingestion are unavailable since mortality occurs from intestinal blockage due to precipitated aluminum rather than through systemic aluminum toxicity (Seiler et. al., 1988). Thus, although the total and available aluminum concentration is elevated compared to the LOAEL, the LOAEL was derived based on exposure to dissolved aluminum in water, and aluminum in sediment is expected to have a relatively low toxicity to mink due to its limited sorption potential in the gut.

Therefore, any contaminants in Ned's Pond, Pond #2, and/or the on-site marsh exceeding the reference area are not expected to pose an elevated risk to mink that may be exposed to contaminants in the surface water, sediment, benthic infauna, or fish through ingestion exposure.

### 3.5 Risk Characterization

Benthic Infauna

Based on the POC concentrations identified in the sediment and surface water of Ned's Pond, Pond #2, and the on-site marsh, no adverse effects are expected to benthic infauna at the population level (i.e. greater than 10% increased mortality, based on the measurement endpoint defined in Table 3.2) in these ponds because of the following:

- The majority of the contaminants identified in the sediment and surface water Ned's Pond, Pond #2, and/or the on-site marsh were similar in concentration to the reference areas, with several contaminants higher in the reference areas;

- Although several parameters exceeded the ISQG in Ned's Pond and/or Pond #2, or exceeded the ISQG and PEL in the on-site marsh, toxicity and Microtox testing indicated no increased mortality (less than a 10% difference) or decreased weight to amphipods, and no elevated decrease in bioluminescence to bacteria, based on the 14 day amphipod growth and survival test and the 30 minute Microtox Solid-Phase test. Therefore, any contaminants in the sediment are not expected to causing elevated adverse effects to benthos in Ned's Pond, Pond #2 or the on-site marsh; and

Brook Trout

Based on the POC concentrations identified in the sediment, surface water, and fish tissue (fillets and carcasses) of Ned's Pond, Pond #2 and/or the on-site marsh, no adverse effects are expected to brook trout at the population level (i.e. greater than 10% increased mortality) in these ponds because of the following:

- low POC concentrations were identified in the surface water in comparing the 95$^{th}$ UCL to generic screening criteria (CCME, 2001 and/or GCDWQ) and the reference area;
- POC concentrations identified in the fish collected from Ned's Pond and Pond #2 are generally the same or lower than the reference areas, with the exception of acenaphthene, barium, cadmium, copper, mercury, and vanadium in fish carcasses and/or fillets, which were between 0.01 and 1.04 mg/kg higher than the reference area; and
- POC concentrations identified in the fish collected from Ned's Pond and Pond #2 are either similar to or below the average literature-based parameter concentrations for fish collected from sites near areas of human occupation (i.e. not from uninhabited areas such as in certain areas of the Canadian Northwest Territories).

Black Ducks

Based on the POC concentrations identified in the sediment, surface water, and low toxicity identified in benthic toxicity testing of sediment from Ned's Pond, Pond #2 and the on-site marsh, no adverse effects are expected to black ducks at the population level (i.e. greater than 10% increased mortality) inhabiting these ponds because of the following:

- There would be limited opportunity for direct exposure to surface water (i.e. sorption through skin) due to the impermeability of their down, and to sediment (which would likely only occur during feeding and near the edges of the ponds and marsh);
- Based on expected daily intake rates of surface water, sediment, and benthic infauna by black ducks, no unacceptable risks are expected due to ingestion exposure of POCs in water, sediment and/or benthic infauna of Ned's Pond, Pond #2, or the on-site marsh, based on the applicable ecotoxicity values for black ducks, mallard ducks or other bird species where no duck data was available;
- It is unlikely that Ned's Pond and Pond #2 would constitute the exclusive food source for resident black ducks because this species is migratory and not expected to be present in the watershed for more than six months each year, thus limiting exposure duration; and
- Despite the one anomalous detectable sediment sample collected for PCB analysis in the on-site marsh (ADI, 1998), no PCBs have been identified in the sediment of the marsh, Ned's Pond or Pond #2, or in the fish collected from Ned's Pond or Pond #2, and are therefore not considered to be present and available for bioaccumulation up the food chain to be a potential risk to black ducks.

Mink

Based on the POC concentrations identified in the sediment, surface water, fish and low toxicity identified in benthic toxicity testing of sediment from Ned's Pond, Pond #2 and the on-site marsh, no adverse effects are expected to mink at the population level (i.e. greater than 10% increased mortality) inhabiting these ponds because of the following:

- Based on the expected daily intake rates of surface water, sediment, benthic infauna and fish (tissue and carcasses) by mink, no unacceptable risks are expected due to ingestion exposure of POCs in water, sediment, benthic infauna and/or fish in Ned's Pond, Pond #2 and/or the on-site marsh, based on applicable ecotoxicity values for mink.

### 3.6 Uncertainty Assessment

Risk estimates normally include an element of uncertainty, and generally these uncertainties are addressed by incorporating conservative assumptions in the analysis. As a result, risk assessments tend to overstate the actual risk. The uncertainty analysis is included to demonstrate that the assumptions used were conservative. Table 3.10 contains a summary of the assumptions used in the risk analysis, provides an evaluation of each, and an opinion as to whether the assumption is acceptable.

**Table 3.10: Evaluation of Assumptions in the Risk Assessment**

| Factor/Assumption | Justification | Analysis Likely to Over or Underestimate Risk | Acceptable Assumption ? |
|---|---|---|---|
| Assumed that the UAS site has been adequately delineated in terms of potential chemical impacts resulting from the disposal of steel barrels and other waste debris | The area north of the developed portion of the UAS site appears to have been extensively modified with partial infilling of Pond #2 and diversion of water to an arm of Ned's Pond (between 1949 and 1966). Waste debris, including Barrel Dump #1 was identified in this area, however, intrusive investigation of much of the area north of the on-site marsh and Barrel Dump #1 does not appear to have occurred (ADI, 1997-2000). In addition, the infilling of the portion of Pond #2 is believed to have resulted in the creation of the on-site marsh, which contained the highest sediment concentrations of zinc and several PAHs tested (of Ned's Pond, Pond #2 and the on-site marsh). This area was believed to have been the waste disposal area of the site during its operation as the U.S. Air Force UAS. However, due to the length of time any potential contaminants have been on-site, it is expected that any elevated contaminant concentrations would have migrated from the source to the adjacent water bodies. Since the contaminant concentrations in the sediment and surface water are low in comparison to screening criteria and/or background concentrations, no new contamination is expected in Ned's Pond, Pond #2 or the on-site marsh as a result of any impacts which are present in the soil and/or groundwater at the site. | Potential under-estimate | Yes |
| Assumed 95$^{th}$ UCL on the mean of all samples collected during the most recent field program were representative of expected concentrations present in the various media | Confidence limits are used to describe a range within which a true value lies within a stated probability. This approach is based on USEPA (1989) which states that the expected exposure concentration should be the arithmetic average of the identified concentrations. Because of uncertainty associated with any estimate of the exposure concentration, it is recommended that the upper confidence limit on the estimate of the arithmetic | Potential under-estimate | Yes |

**Table 3.10: Evaluation of Assumptions in the Risk Assessment**

| Factor/Assumption | Justification | Analysis Likely to Over or Underestimate Risk | Acceptable Assumption ? |
|---|---|---|---|
| | mean be used as the expected exposure concentration (USEPA, 1989). In addition, due to the estimated age of the impacts (approximately 50 years old), parameter concentrations are likely at a 'steady-state' and are not expected to increase substantially unless new parameters are introduced. Thus, the 95$^{th}$ UCL is expected to be an appropriate representation of the typical concentration expected to be present for each parameter in each media. | | |
| Qualitative use of sample data collected prior to November-December, 2001 | Based on the limited data collected and the review by Cantox which concluded the data was 'useable', however, "could be superseded by the collection of new or additional data". With the exception of PCBs which were identified in sediment by ADI, all other sample results were consistent with the results of the extensive sampling program which was conducted in November-December, 2001. PCBs were not detected in any of the water, sediment or fish samples collected from Ned's Pond or Pond #2, and therefore the previous PCB result is not considered representative of actual site conditions and was therefore not assessed in this study. | Potential under-estimate | Yes |
| Use of other bird toxicity data where black duck data was not available | Where possible, mallard duck toxicity data was used as a surrogate for black duck toxicity data. Where this was not possible, any toxicological information pertaining to bird exposure to the POCs was used. Although extrapolation from ducks to other bird species may not be appropriate, the toxicity values from these other species were much higher than the identified site concentrations. Thus, any differences in species (i.e. sensitivities) are expected to be accounted for in the difference between the maximum site concentration and the ecotoxicity value. | Potential under-estimate | Yes |
| Utilized the latest (Nov.-Dec., 2001) on-site marsh sediment toxicity results in the assessment of adverse effects to benthic infauna in the on-site marsh (Environment Canada, 2002b) | The most recent data for the on-site marsh indicates no elevated toxicity to amphipods and bacteria. Previous data from 2001 indicated elevated toxicity to amphipods and bacteria in certain samples. These previous samples submitted were above the temperature recommended for sample submission. This may have affected the integrity of the results. Therefore, the results of the previous toxicity study cannot be relied upon to provide an accurate representation of the toxicity of the sediment collected, and they should not be and were not relied upon. | Potential under-estimate | Yes |
| Selection of VECs included benthic infauna, brook trout, black ducks, and mink | These organisms were considered to be either the most likely to be exposed (i.e. benthic infauna), serve as surrogate for other species (brook trout and mink), and/or are important to humans (brook trout, black ducks, and mink). All other potential receptors likely present are either transient, not as likely to be exposed as the selected VECs or are not considered rare or endangered at the population level. | Potential under-estimate | Yes |

## 4. SUMMARY AND CONCLUSIONS

General Site Conditions

The on-site soil and groundwater impacts are expected to have been the result of activities which have occurred on-site primarily between 1943 and 1966, during its use as a US Air Force Base. Any resultant impacts in the sediment and surface water of Ned's Pond and/or Pond #2 as a result of on-site contaminants leaching from barrels/soil to groundwater and groundwater discharge to these ponds is expected to have occurred during this time. Therefore, the identified impacts are expected to represent the reasonable worst-case scenario of on-site contaminants leaching to groundwater and subsequent discharge to the nearby surface water bodies. Unless new chemicals are introduced on-site, new contamination from the site to Ned's Pond or Pond #2 is not expected to be detrimental to the overall water and sediment quality.

The majority of the site with potential environmental concerns has been adequately delineated previously by ADI (1997-2000). However, the area north of the on-site marsh, Barrel Dump #1, and the identified remaining barrels (not removed due to slope instability along the northern edge of the developed portion of the site) has not been fully delineated to determine potential POCs. Although not expected based on the history of the site and discussions with those familiar with the site, there is the potential for contamination to exist in this area due to its former usage as a waste disposal area for the site. However, if large volumes of contaminated material were present in this area, it is expected that any such material would have leached from its original location and would have been identified in any of the field program samples, including the sediment and surface water samples collected by Environment Canada in November-December, 2001.

Ecological Receptor Health:

Benthic Infauna

- Based on the parameter concentrations identified in the sediment and surface water and the Microtox and amphipod toxicity testing results, no unacceptable risks are expected to benthic infauna in Ned's Pond and Pond #2.

Brook Trout

- Based on the parameter concentrations identified in the sediment, surface water and fish tissue, no unacceptable risks are expected to brook trout in Ned's Pond and Pond #2 in comparison to the reference areas.

Black Ducks

- Based on the parameter concentrations identified in the sediment and surface water, and based on toxicity testing and BSAF factors for sediment contaminants to benthic infauna, exposure to the surface water, sediment, or ingestion of benthic infauna in Ned's Pond, Pond #2 and/or the on-site marsh is not expected to pose unacceptable risks to black ducks.

Mink

- Based on the parameter concentrations identified in the sediment, surface water, and fish (fillets and carcasses), and based on toxicity testing and BSAF factors for sediment contaminants to benthic infauna, exposure to surface water, sediment, or ingestion of benthic infauna or fish from Ned's Pond, Pond #2 and/or the on-site marsh is not expected to pose unacceptable risks to mink.

## 5. RECOMMENDATIONS

Based on the screening level ecological risk assessment contained herein, the following recommendations are provided:

- No further action is required to ensure the protection of ecological receptors. Any elevated POC concentrations are expected to be limited to localized areas which are not expected to constitute an elevated risk to populations of aquatic receptors in the area. No elevated risks are expected to the VECs from exposure to contaminants in Ned's Pond, Pond #2 and/or the on-site marsh in comparison to the reference areas.

- The screening assessment is considered sufficient in order to assess the potential risks to receptors exposed to the sediment, surface water, benthic infauna, and/or fish of Ned's Pond and/or Pond #2. No further assessment (i.e. Preliminary Quantitative Risk Assessment) is required to reduce the level of uncertainty contained within this report.

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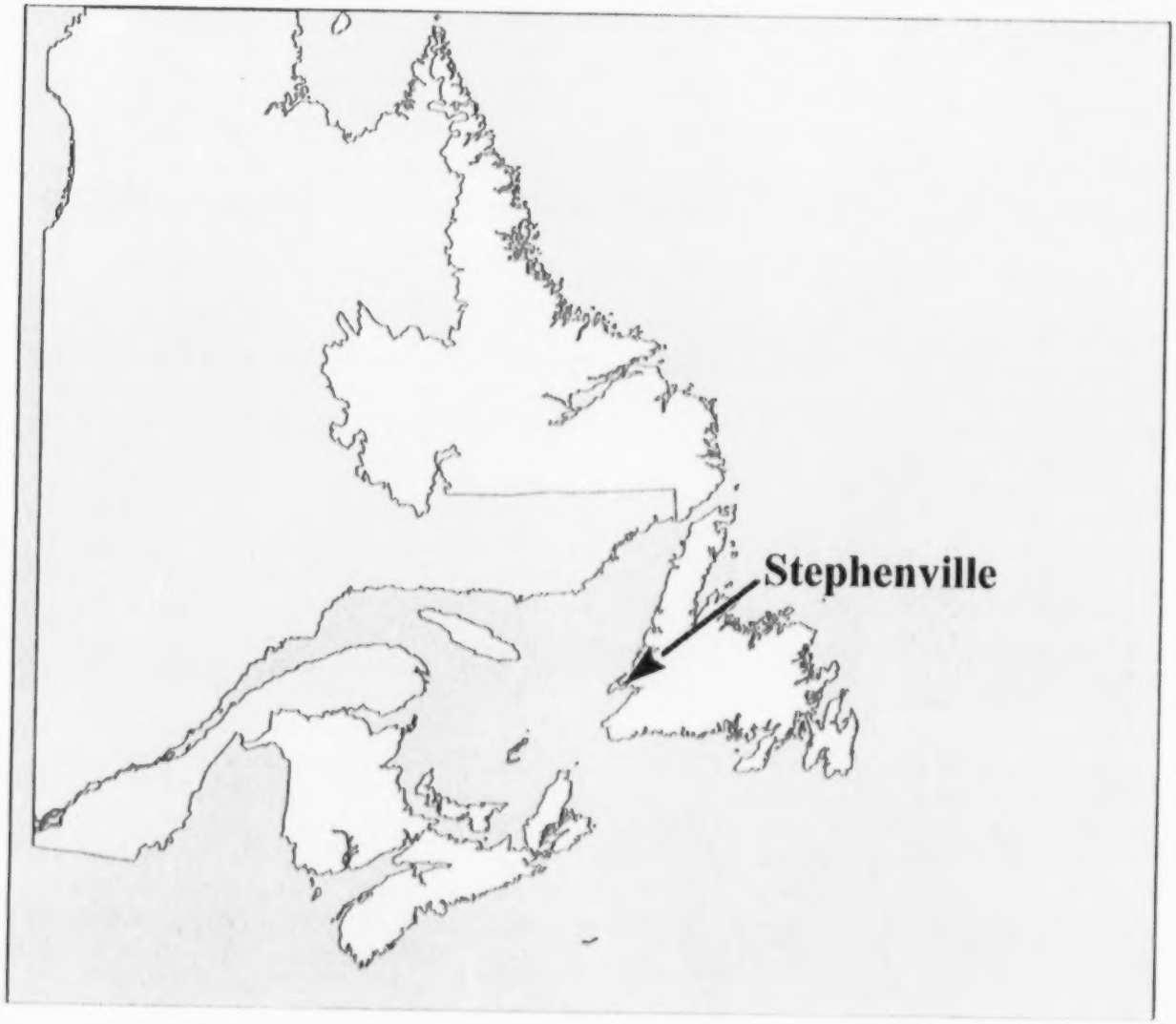
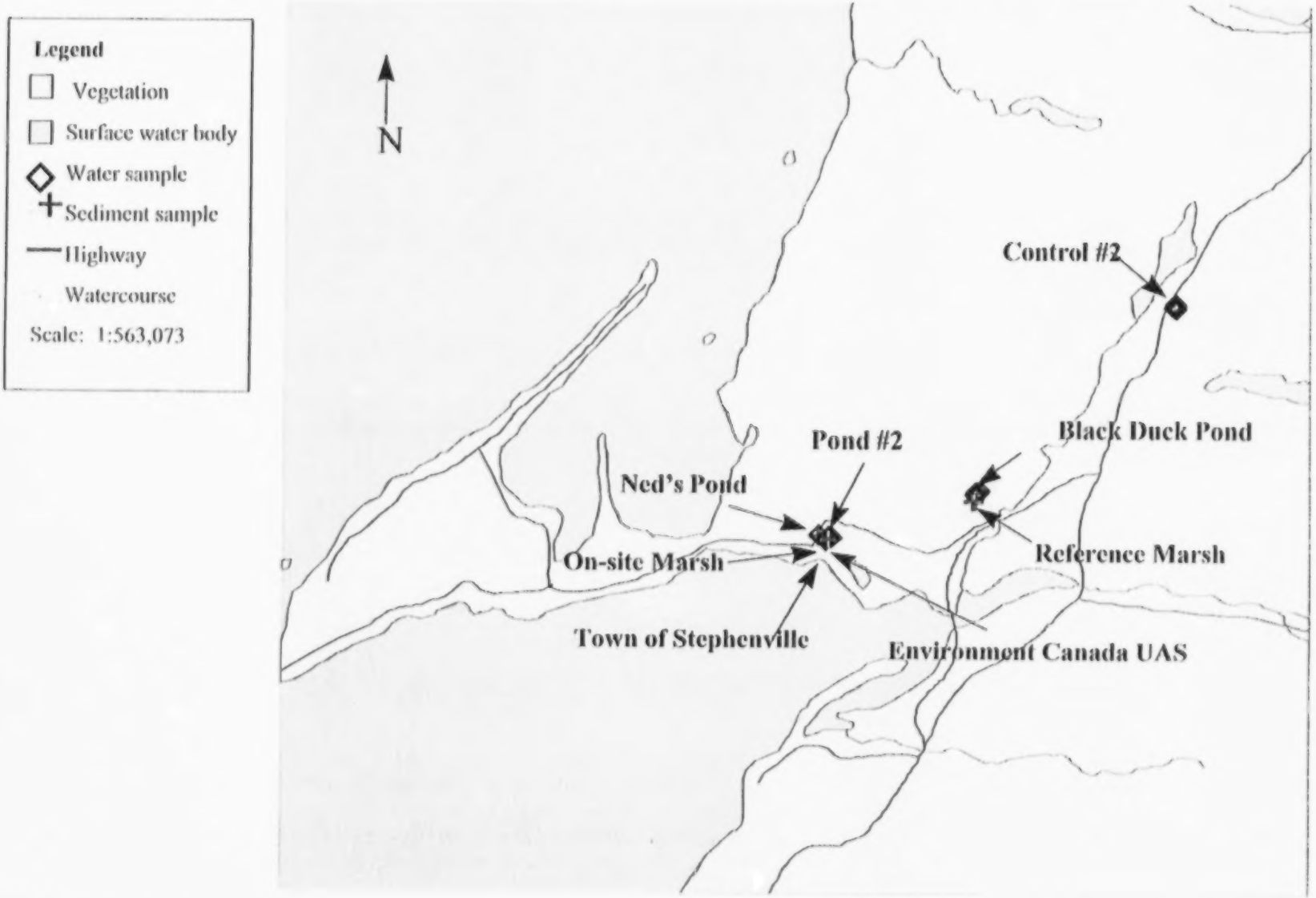
# APPENDIX A

# SAMPLE LOCATIONS

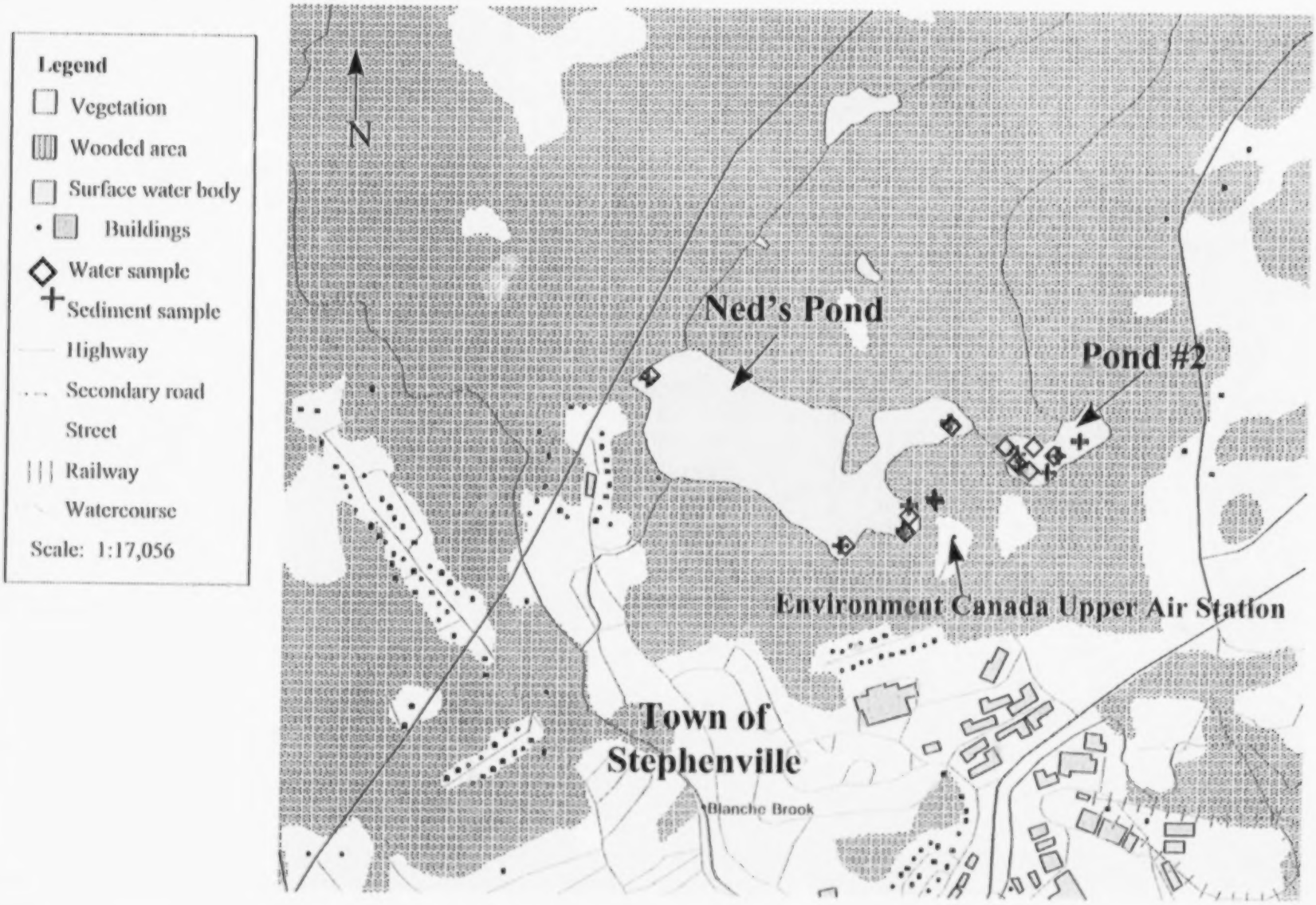
Figure 1: Stephenville, Newfoundland



# Figure 2: Sediment and Surface Water Sampling Locations



# Figure 3: Environment Canada UAS and Town of Stephenville



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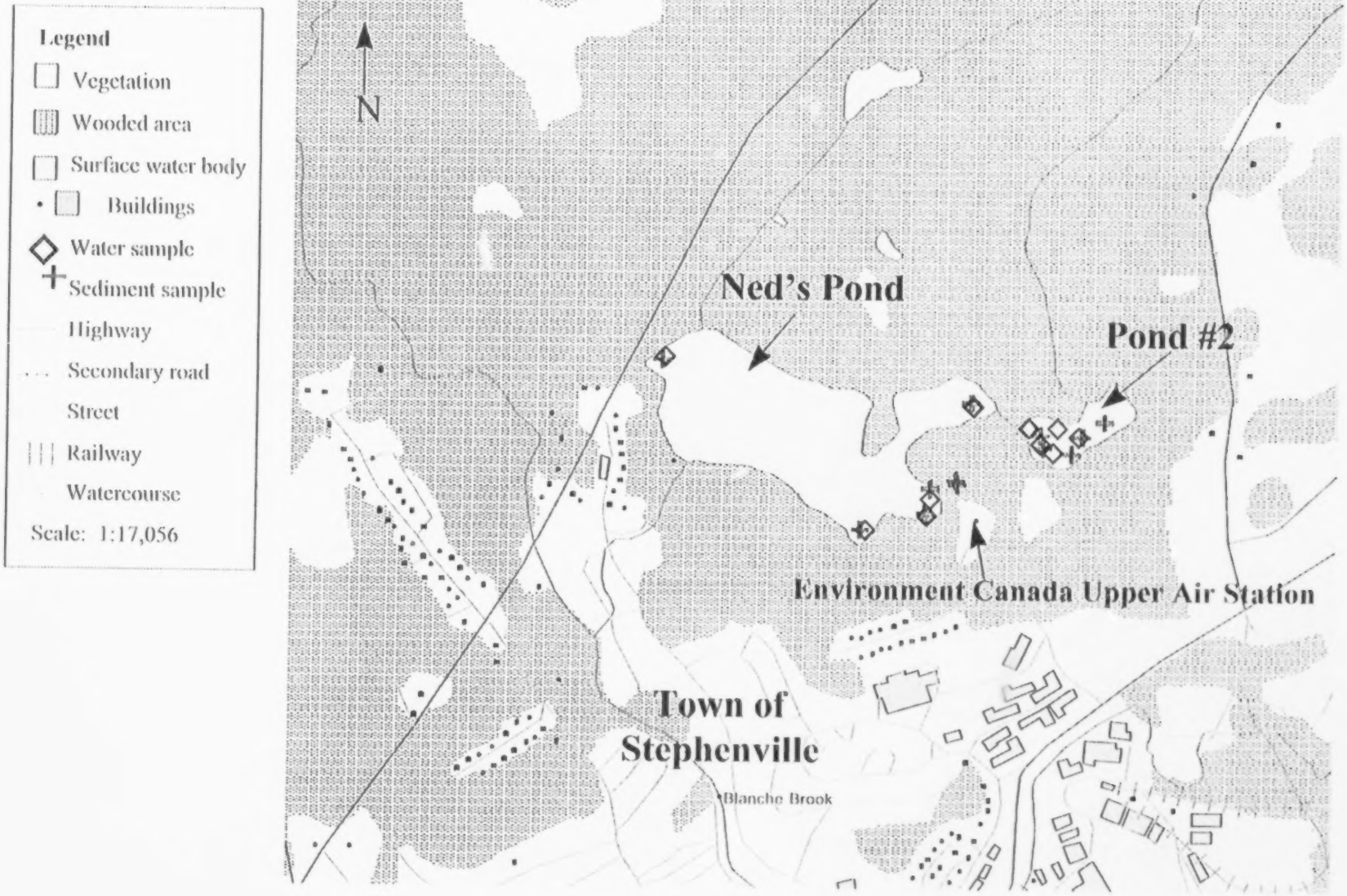
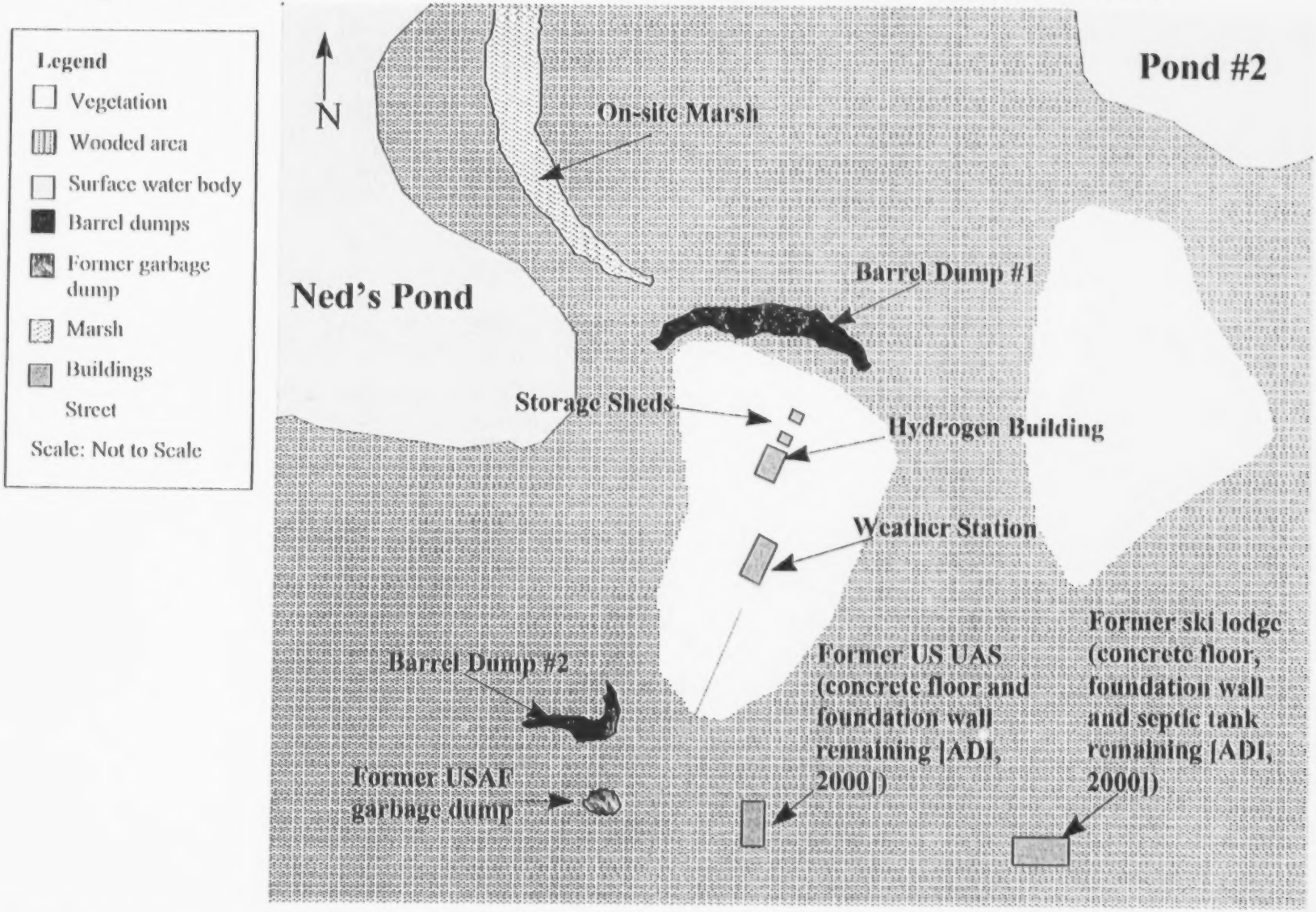
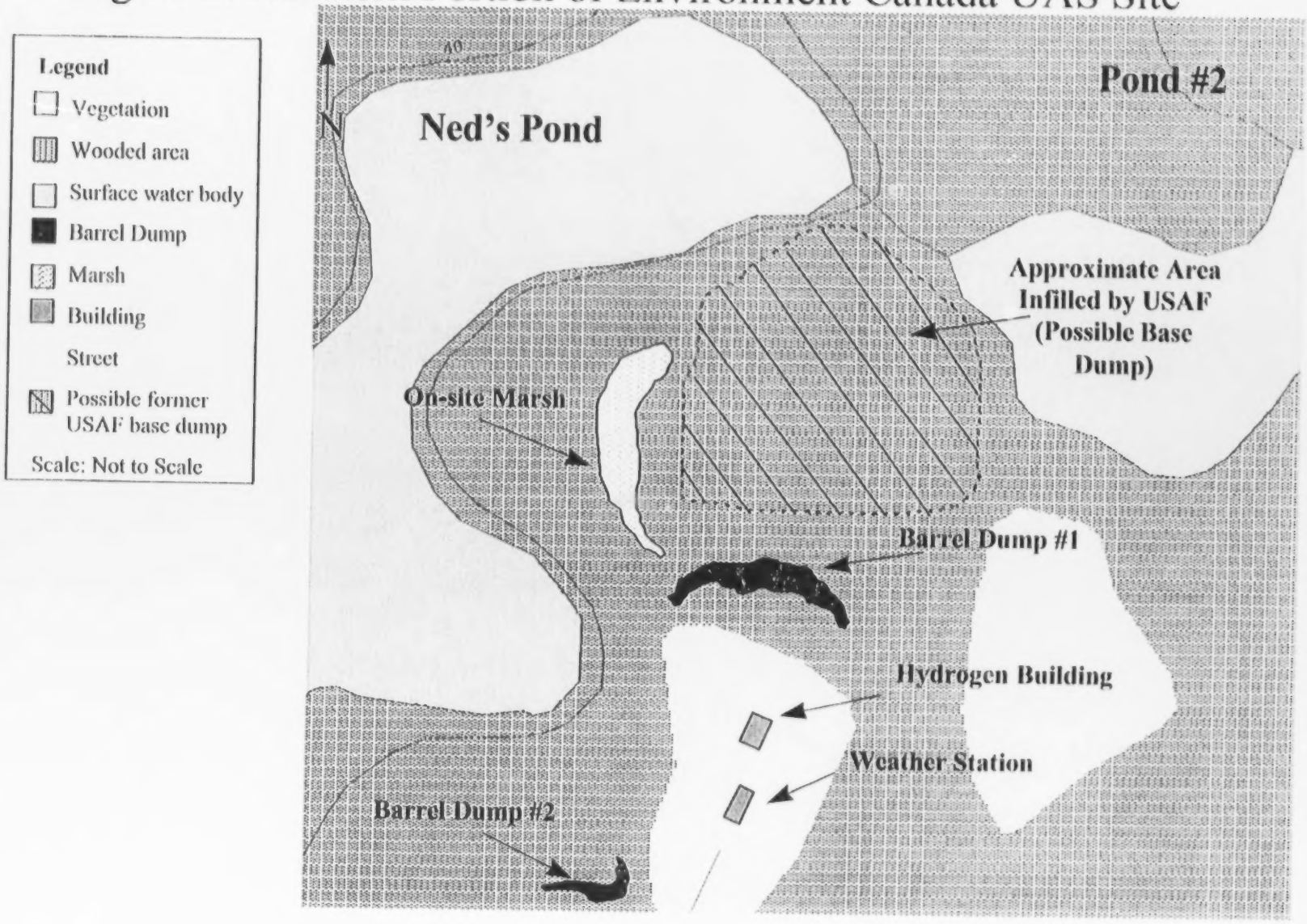


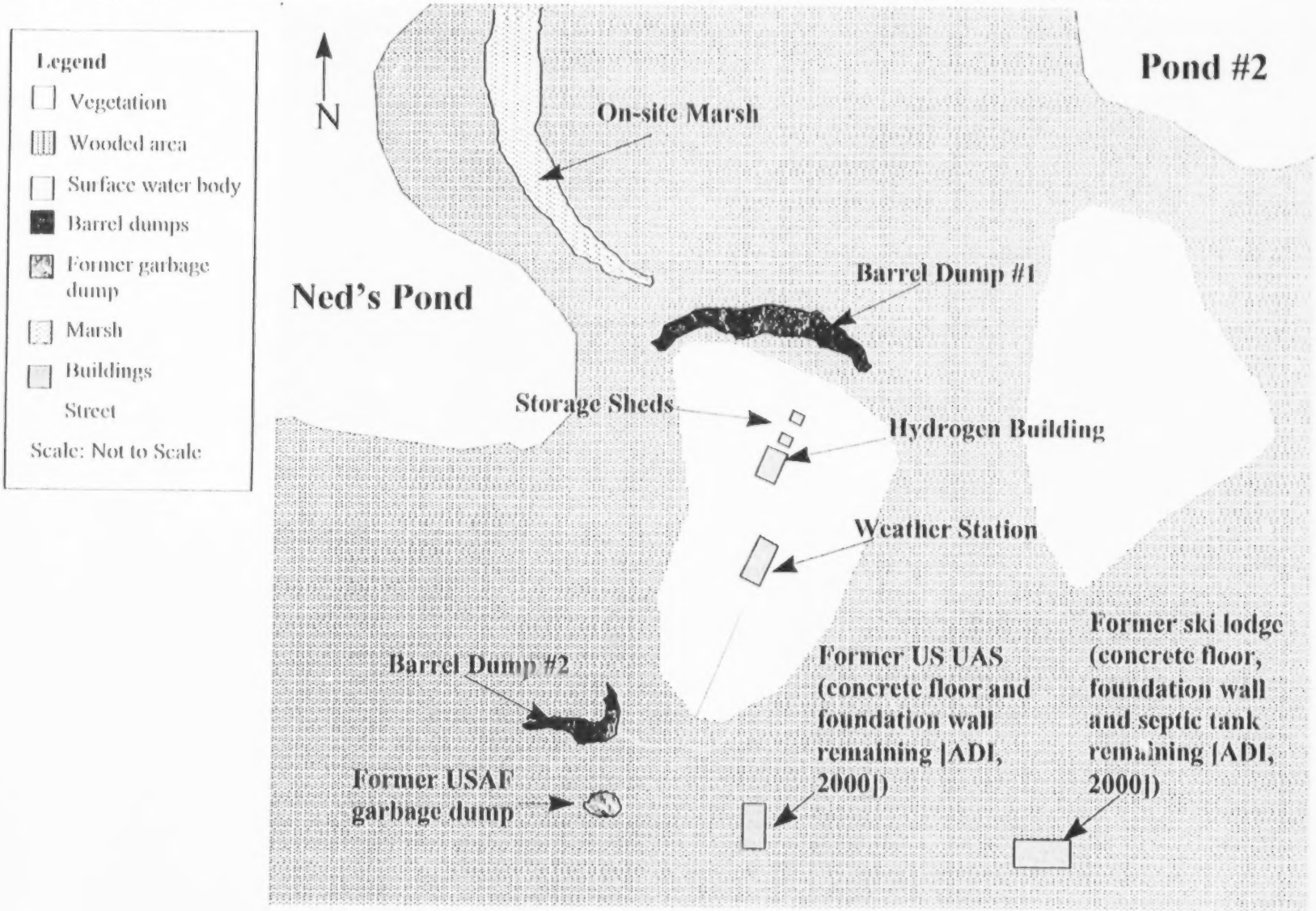
# Figure 4: Southern Portion of Environment Canada UAS Site



# Figure 5: Northern Portion of Environment Canada UAS Site



# Figure 4: Southern Portion of Environment Canada UAS Site



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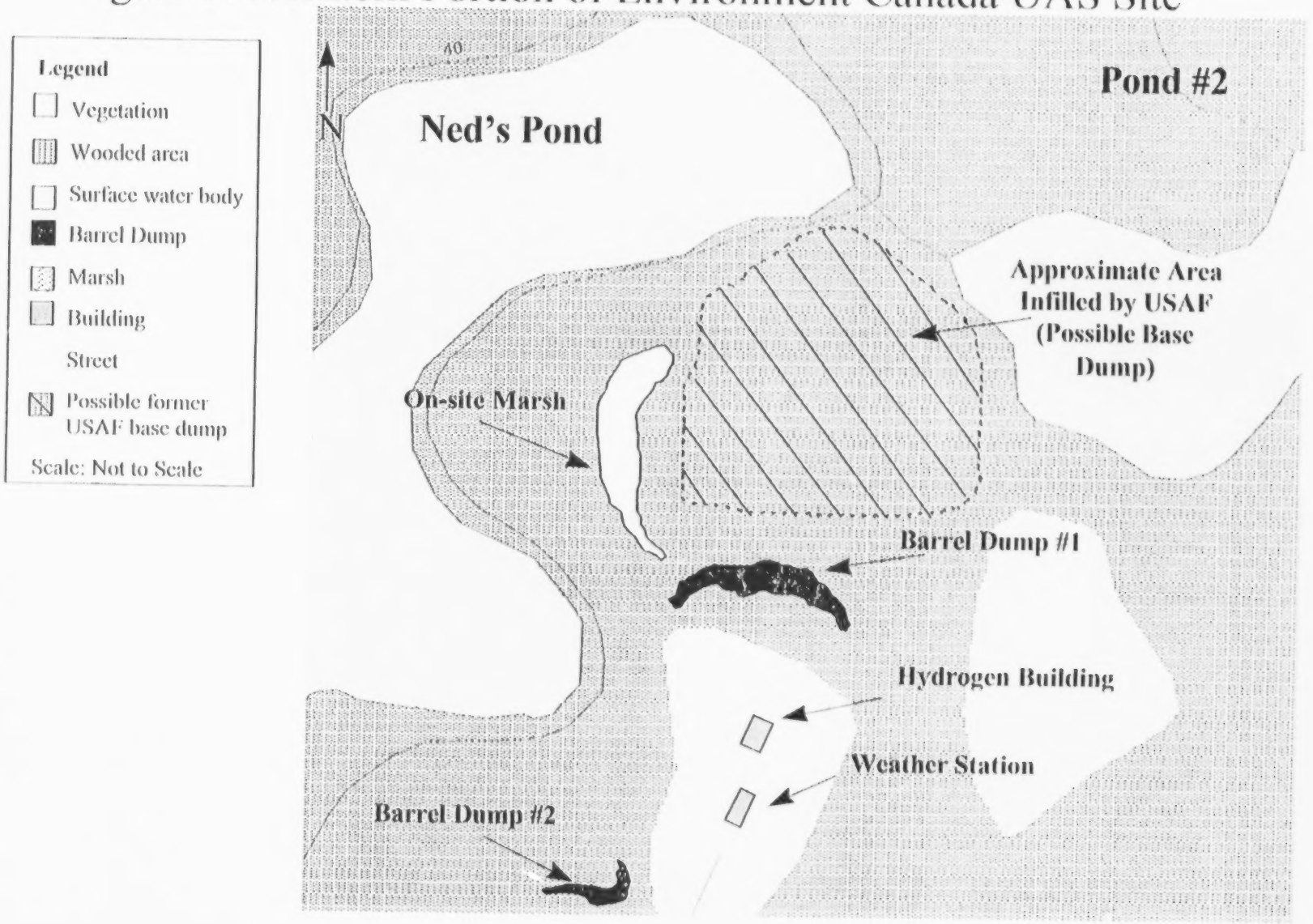
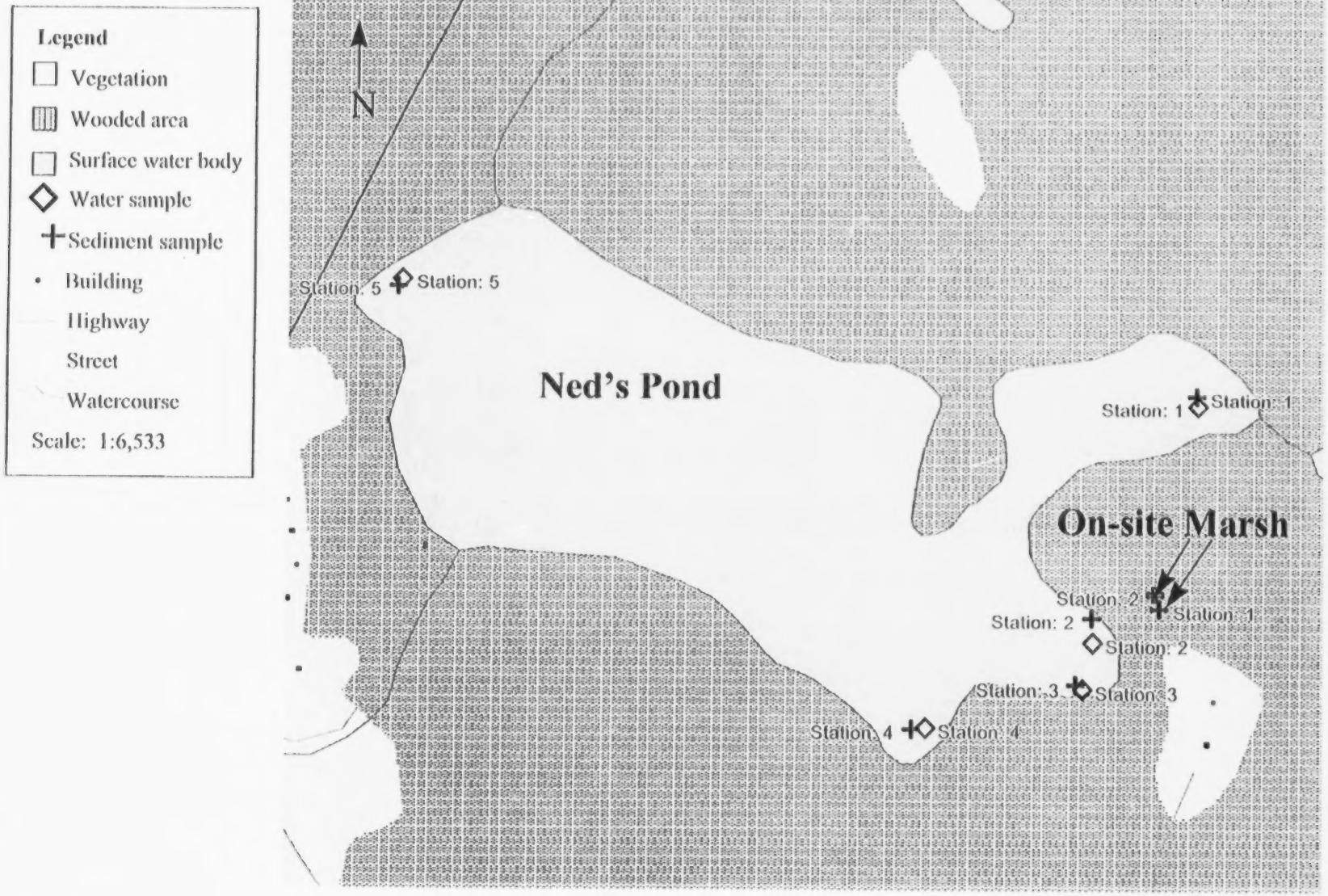
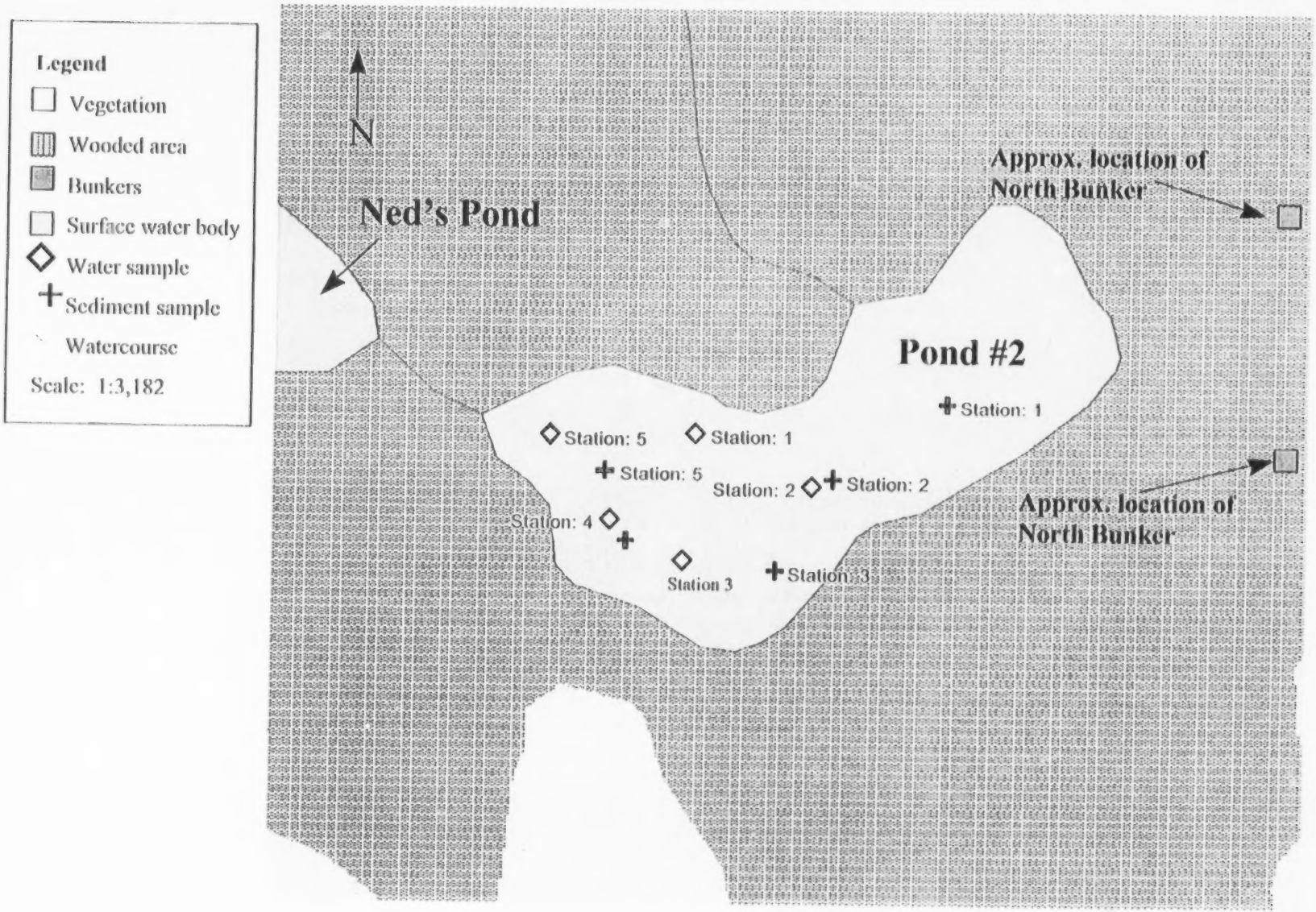


# Figure 6: Ned's Pond and On-site Marsh Sampling Locations



# Figure 7: Pond #2 Sampling Locations



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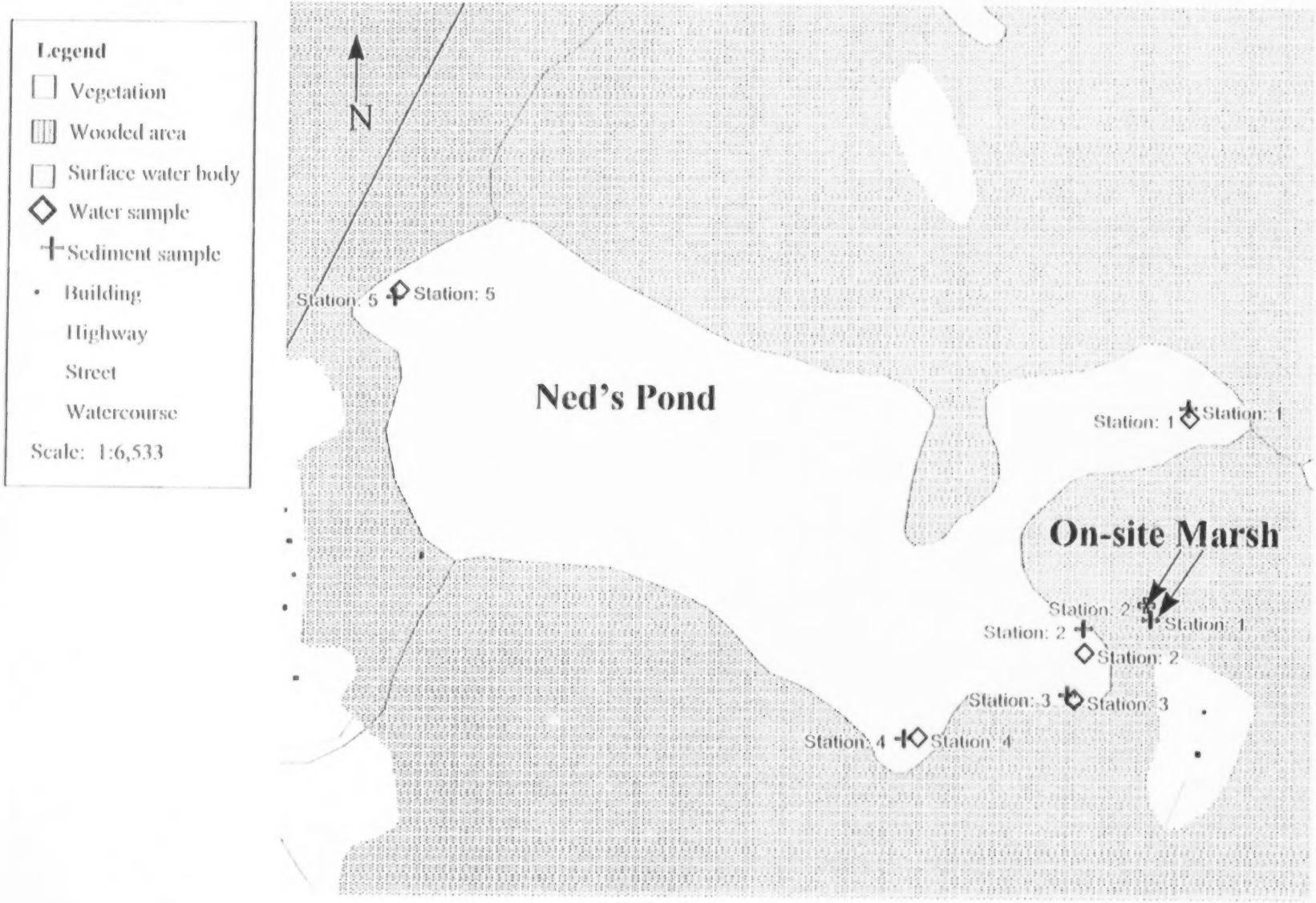
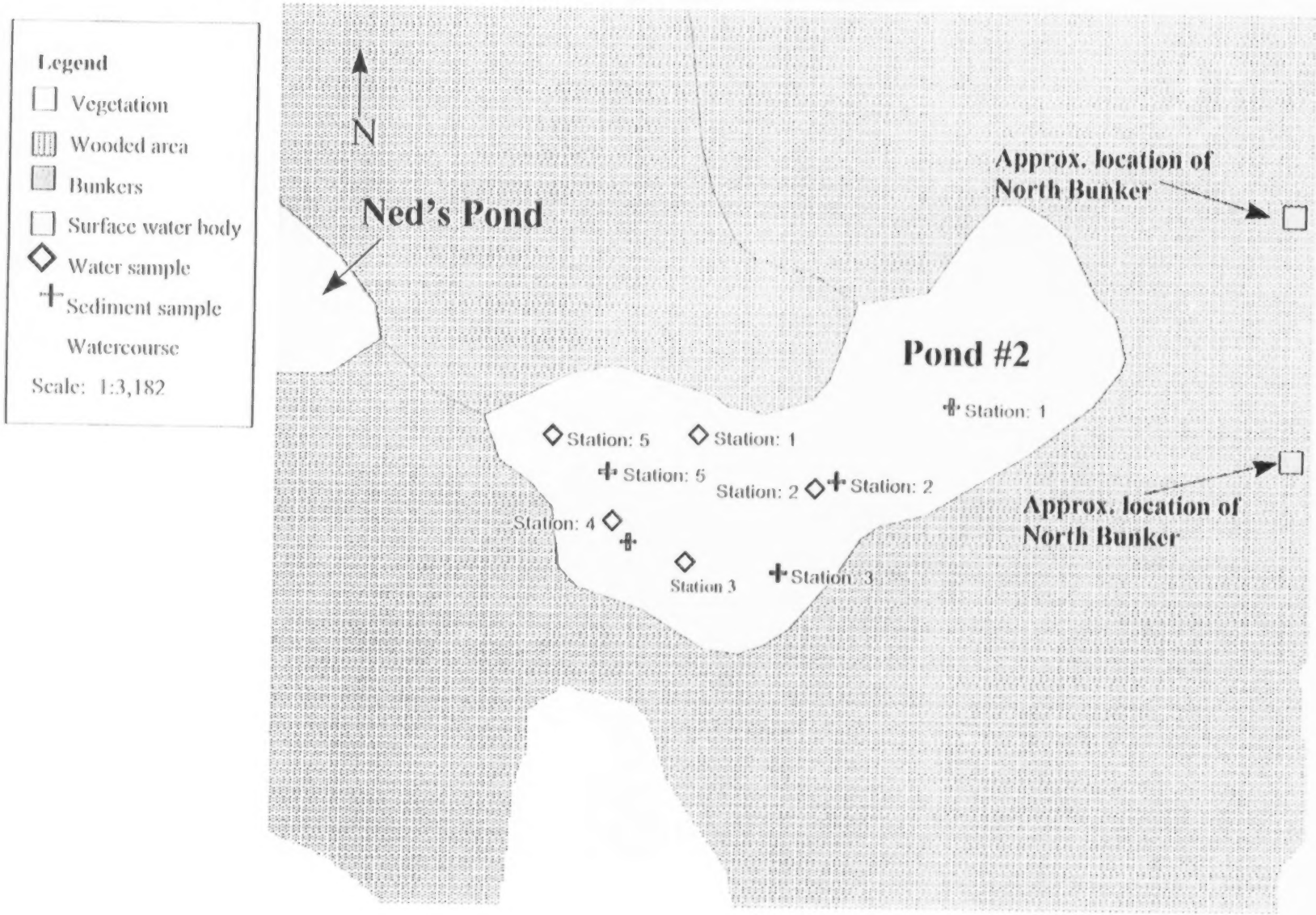
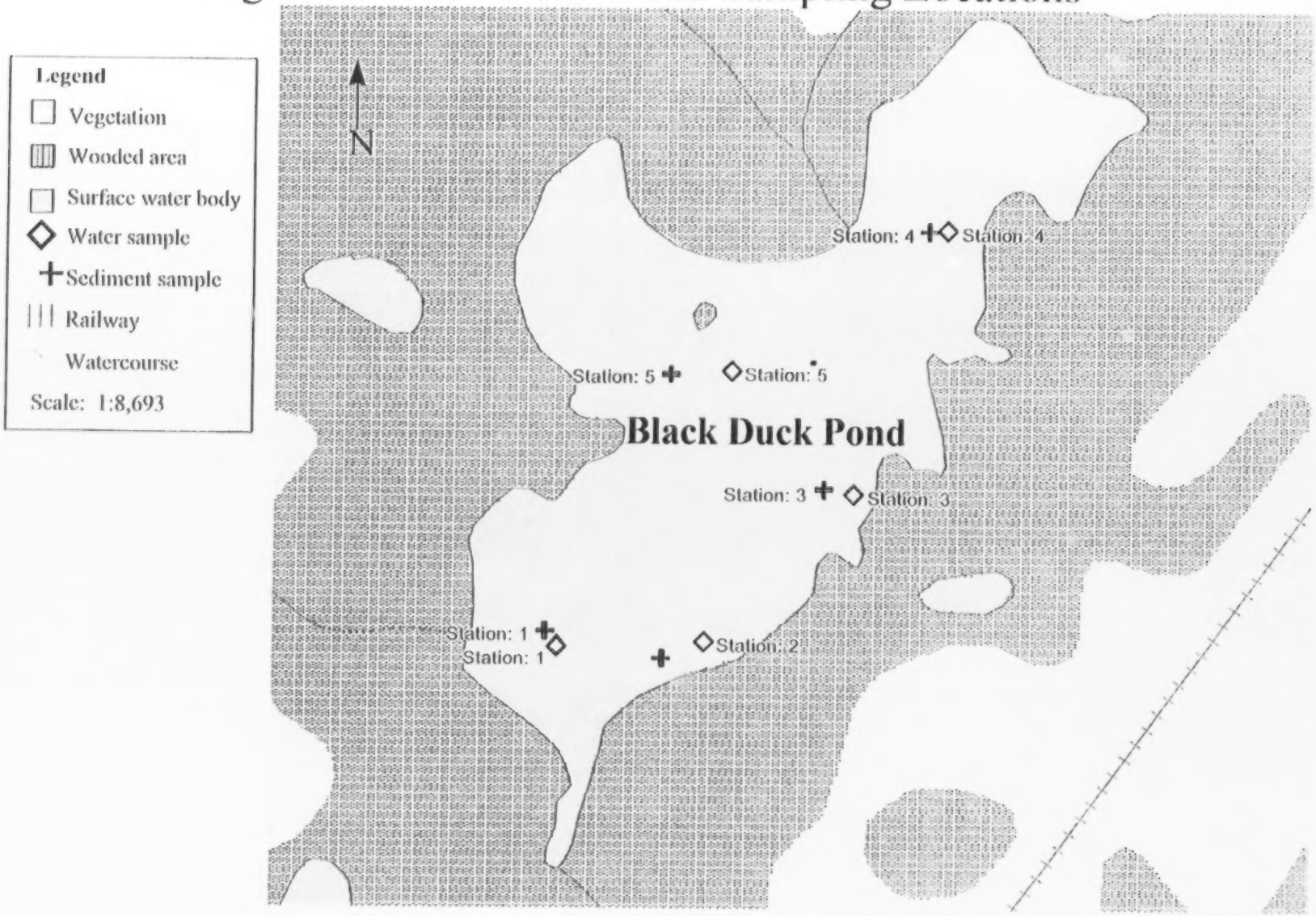


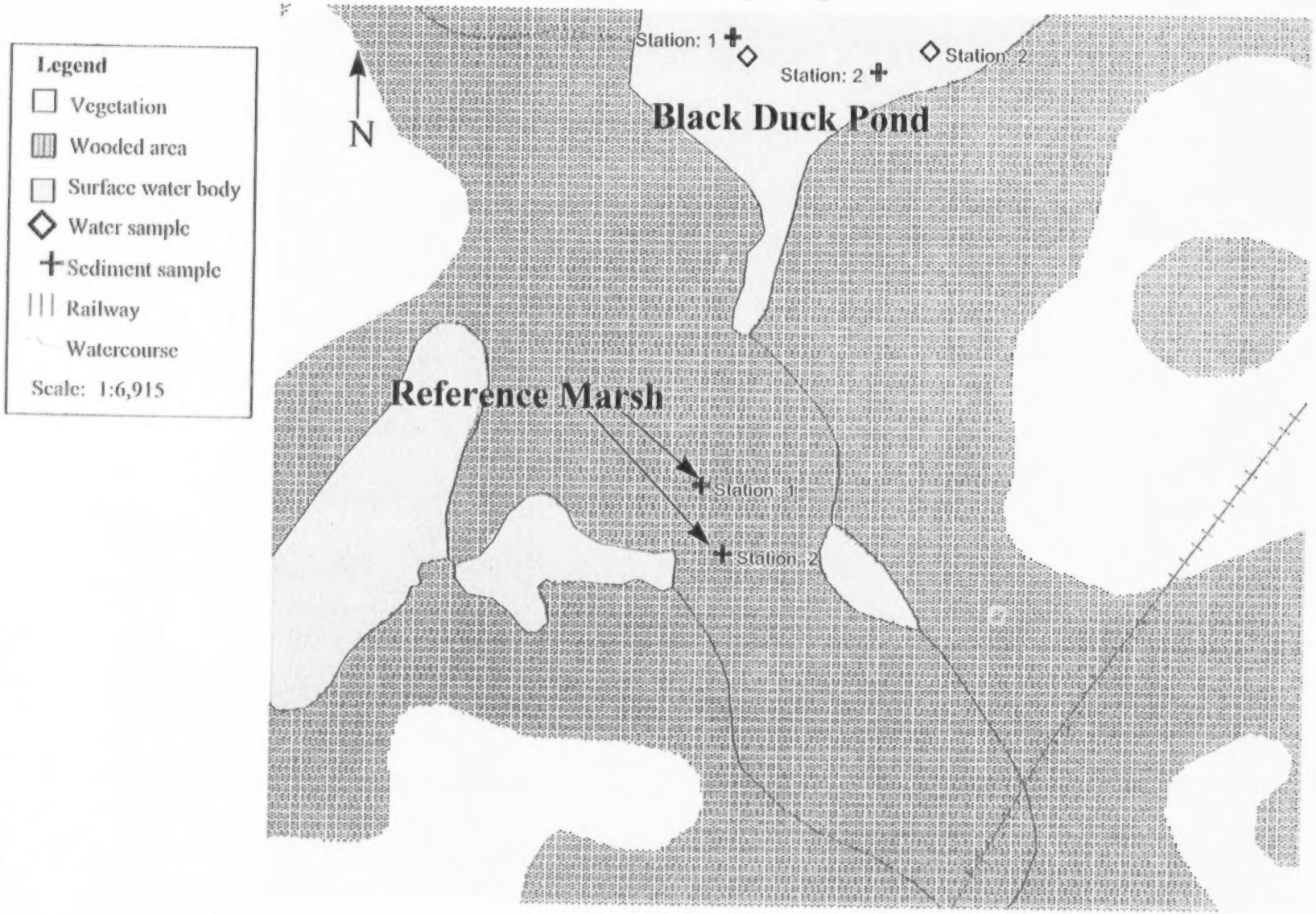
# Figure 7: Pond #2 Sampling Locations



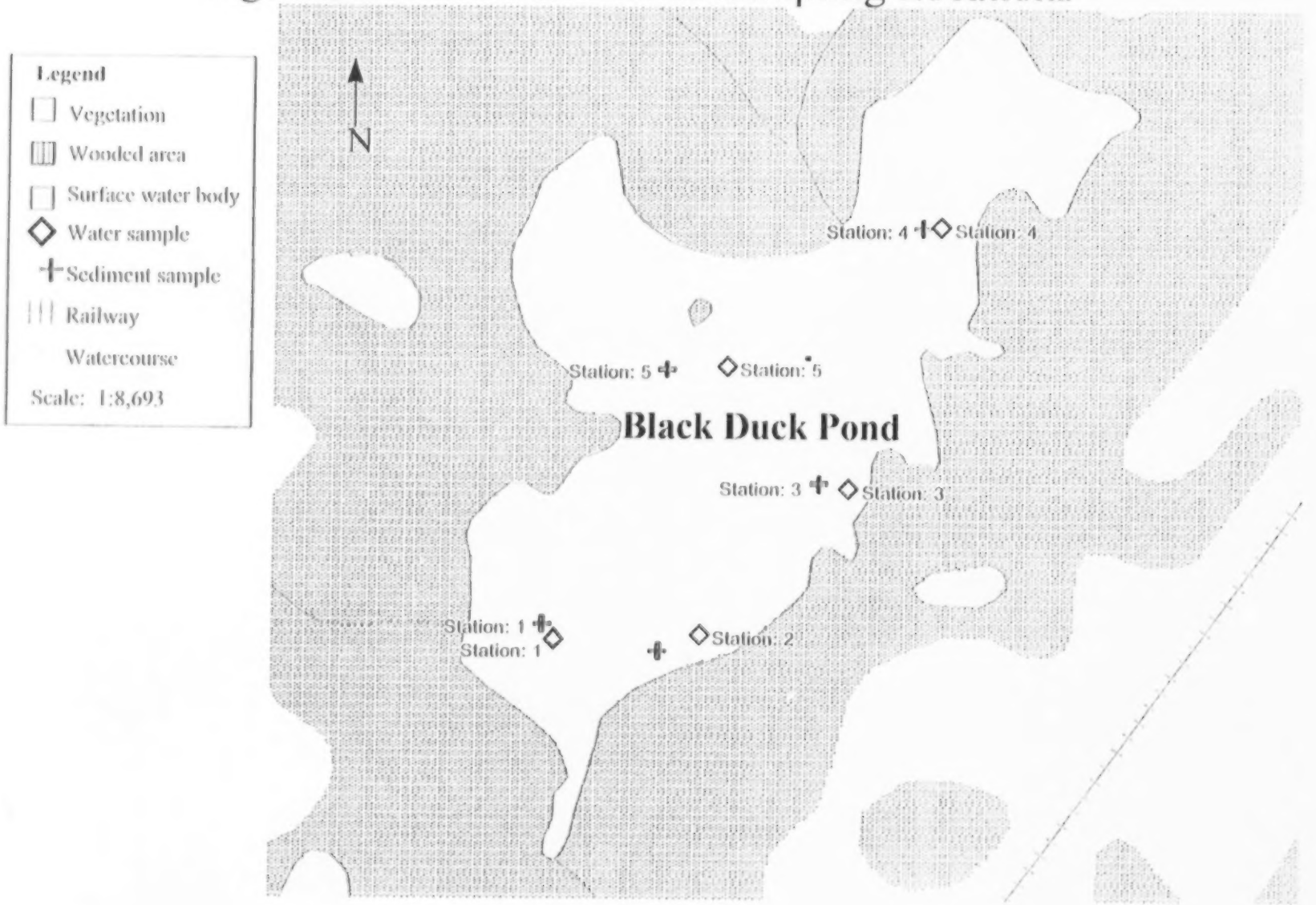
# Figure 8: Black Duck Pond Sampling Locations



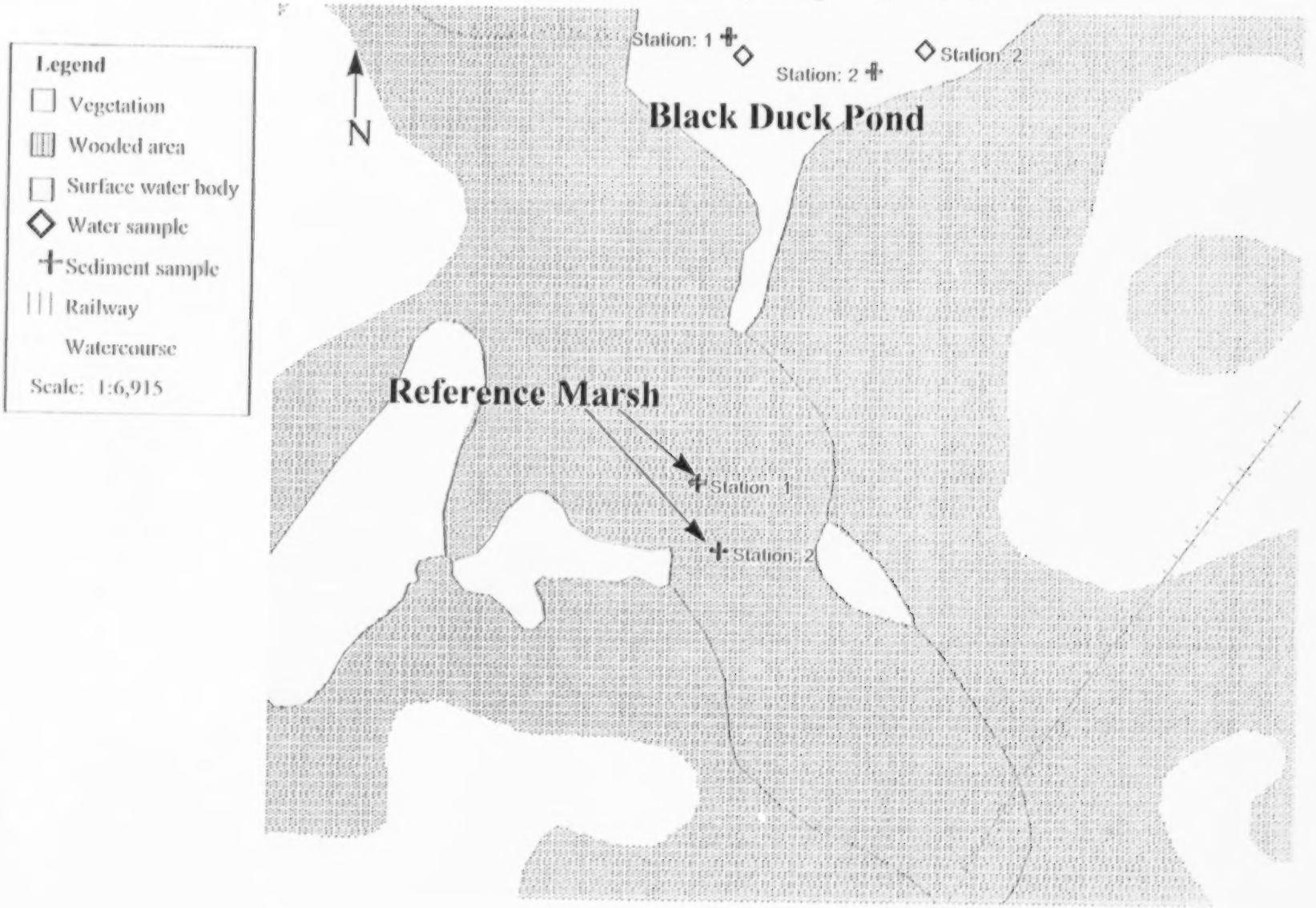
# Figure 9: Reference Marsh Sampling Locations



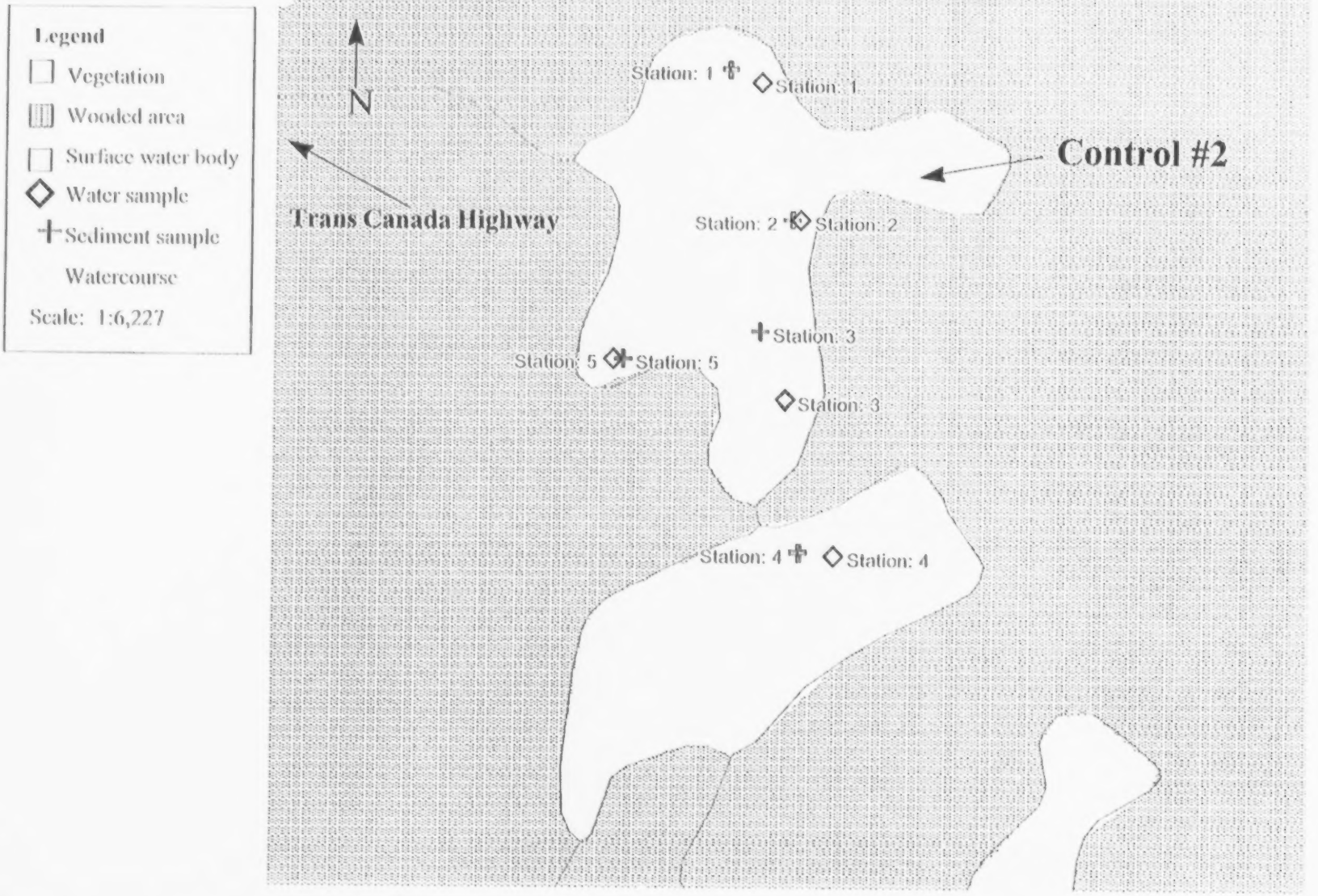
# Figure 8: Black Duck Pond Sampling Locations



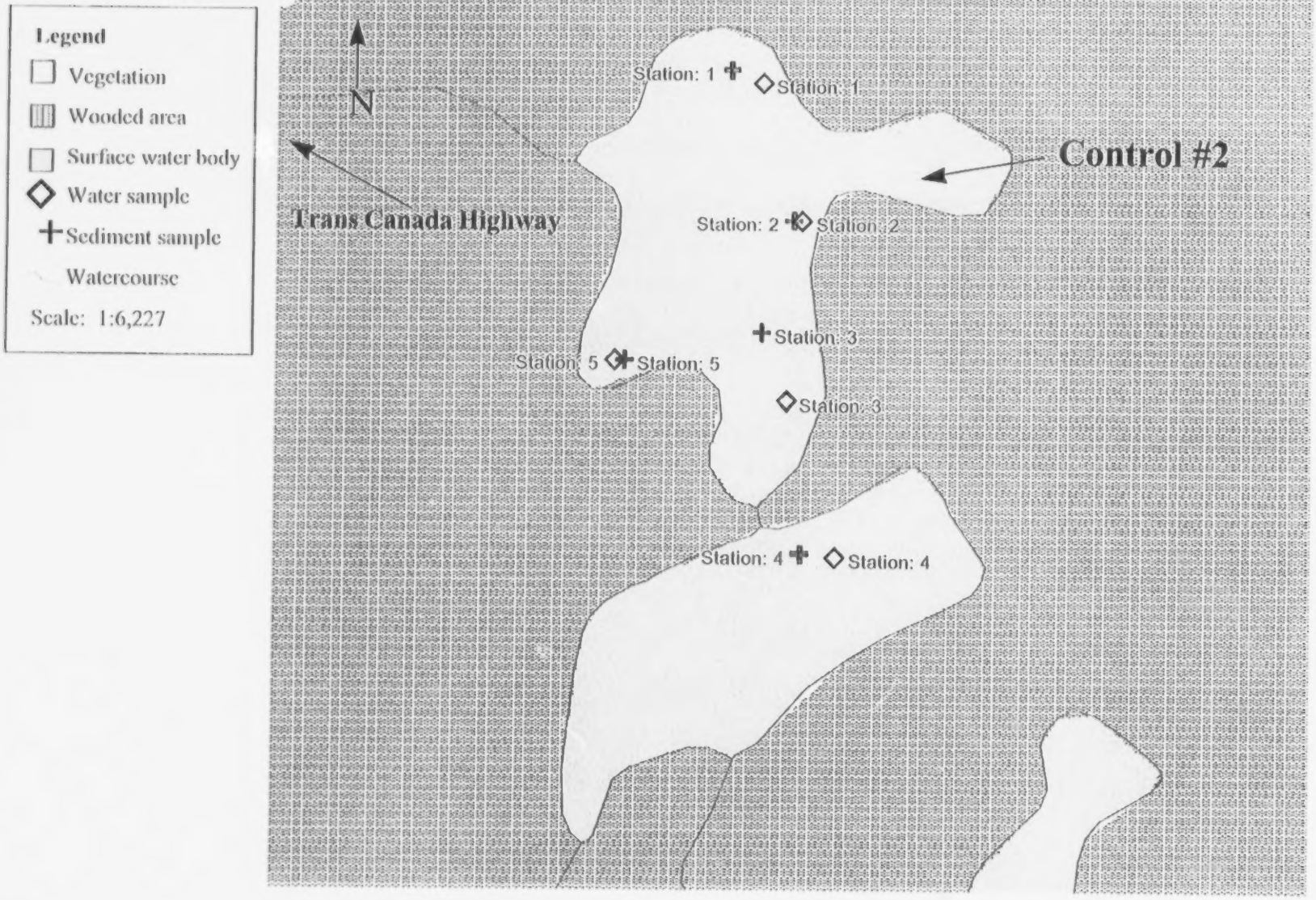
# Figure 9: Reference Marsh Sampling Locations



# Figure 10: Control #2 Sampling Locations



# Figure 10: Control #2 Sampling Locations



# APPENDIX B

# ANALYTICAL SUMMARY TABLES

**Table B.1: Grain Size Analysis**

| Date Sampled<br>Date Reported<br>Lab | Ned's Pond Station 1<br>Nov 27-01<br>Dec 11-01<br>RPC | Ned's Pond Station 2<br>Nov 27-01<br>Dec 11-01<br>RPC | Ned's Pond Station 3<br>Nov 27-01<br>Dec 11-01<br>RPC | Ned's Pond Station 4<br>Nov 27-01<br>Dec 11-01<br>RPC | Ned's Pond Station 5<br>Nov 27-01<br>Dec 11-01<br>RPC | Pond 2 Station 1<br>Nov 27-01<br>Dec 11-01<br>RPC | Pond 2 Station 2<br>Nov 27-01<br>Dec 11-01<br>RPC | Pond 2 Station 3<br>Nov 27-01<br>Dec 11-01<br>RPC | Pond 2 Station 4<br>Nov 27-01<br>Dec 11-01<br>RPC | Pond 2 Station 5<br>Nov 27-01<br>Dec 11-01<br>RPC | Black Duck Pond Station 1<br>Nov 27-01<br>Dec 11-01<br>RPC | Black Duck Pond Station 2<br>Nov 27-01<br>Dec 11-01<br>RPC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <PHI -1 (2 mm) | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| <PHI 0 (1 mm) | 91.5 | 84.7 | 88.8 | 86.6 | 89.6 | 93.7 | 91.5 | 91.2 | 93.7 | 86.5 | 84.4 | 85.9 |
| <PHI +1 (1/2 mm) | 86.7 | 80.9 | 83.0 | 80.0 | 82.9 | 90.3 | 86.9 | 85.6 | 90.6 | 78.5 | 78.6 | 79.0 |
| <PHI +2 (1/4 mm) | 82.8 | 78.9 | 78.2 | 72.7 | 76.1 | 79.2 | 81.9 | 81.9 | 88.2 | 72.5 | 74.0 | 74.1 |
| <PHI +3 (1/8 mm) | 79.7 | 77.1 | 74.7 | 63.2 | 69.8 | 57.6 | 76.5 | 74.3 | 84.3 | 65.7 | 68.1 | 68.1 |
| <PHI +4 (1/16 mm) | 77.0 | 74.9 | 71.3 | 58.7 | 62.2 | 45.2 | 72.5 | 72.8 | 81.5 | 61.7 | 60.4 | 58.6 |
| <PHI +5 (1/32 mm) | 75.0 | 73.8 | 67.3 | 55.6 | 58.6 | 39.0 | 66.0 | 72.6 | 78.6 | 58.8 | 56.0 | 53.7 |
| <PHI +6 (1/64 mm) | 65.2 | 67.7 | 60.9 | 51.4 | 52.2 | 33.4 | 52.2 | 61.5 | 68.9 | 56.0 | 45.1 | 37.4 |
| <PHI +7 (1/128 mm) | 44.2 | 56.2 | 51.6 | 42.7 | 43.2 | 25.0 | 34.2 | 35.4 | 40.2 | 43.7 | 34.1 | 25.4 |
| <PHI +8 (1/256 mm) | 39.4 | 54.4 | 48.5 | 40.1 | 40.0 | 22.7 | 29.8 | 28.0 | 33.4 | 41.5 | 29.7 | 23.6 |
| <PHI +9 (1/512 mm) | 33.2 | 52.7 | 46.6 | 34.5 | 36.6 | 17.9 | 25.1 | 20.4 | 25.6 | 40.5 | 26.1 | 21.3 |
| Gravel | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sand | 23.0 | 25.1 | 28.7 | 41.3 | 37.8 | 54.8 | 27.5 | 27.2 | 18.5 | 38.3 | 39.6 | 41.4 |
| Silt | 37.5 | 20.4 | 22.8 | 18.6 | 22.2 | 22.4 | 42.8 | 44.8 | 48.1 | 20.2 | 30.7 | 35.0 |
| Clay | 39.4 | 54.4 | 48.5 | 40.1 | 40.0 | 22.7 | 29.8 | 28.0 | 33.4 | 41.5 | 29.7 | 23.6 |
| TOC (%) | 19.528513 | 36.8108911 | 33.6191538 | 23.5312066 | 30.961847 | 13.553856 | 17.297947 | 10.501901 | 14.889218 | 24.319844 | 20.32178712 | 15.6968314 |

Notes:
TOC - Total organic carbon
PAS - Philip Analytical Services
RPC - Research and Productivity Lab

**Table B.1: Grain Size Analysis**

| Date Sampled<br>Date Reported<br>Lab | Black Duck Pond Station 3<br>Nov 27-01<br>Dec 11-01<br>RPC | Black Duck Pond Station 4<br>Nov 27-01<br>Dec 11-01<br>RPC | Black Duck Pond Station 5<br>Nov 27-01<br>Dec 11-01<br>RPC | Control Pond 2 Station 1<br>Nov 27-01<br>Dec 11-01<br>RPC | Control Pond 2 Station 2<br>Nov 27-01<br>Dec 11-01<br>RPC | Control Pond 2 Station 3<br>Nov 27-01<br>Dec 11-01<br>RPC | Control Pond 2 Station 4<br>Nov 27-01<br>Dec 11-01<br>RPC | Control Pond 2 Station 5<br>Nov 27-01<br>Dec 11-01<br>RPC | On-site Marsh Station 1<br>Nov 27-01<br>Dec 11-01<br>RPC | On-site Marsh Station 2<br>Nov 27-01<br>Dec 11-01<br>RPC | On-site Marsh Station 1 Sample 2<br>Dec 13-01<br>Jan 7-02<br>PAS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| <PHI -1 (2 mm) | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 90.4 |
| <PHI 0 (1 mm) | 89.9 | 90.2 | 85.0 | 97.8 | 92.6 | 100.0 | 93.2 | 91.2 | 94.3 | 80.4 | 81.6 |
| <PHI +1 (1/2 mm) | 82.3 | 86.8 | 77.2 | 95.1 | 88.5 | 96.4 | 83.4 | 84.1 | 92.7 | 76.3 | 64.5 |
| <PHI +2 (1/4 mm) | 78.0 | 83.3 | 71.6 | 93.4 | 85.9 | 94.6 | 79.9 | 80.5 | 90.8 | 71.3 | 45.7 |
| <PHI +3 (1/8 mm) | 74.8 | 73.6 | 68.1 | 90.0 | 80.2 | 89.9 | 76.1 | 77.7 | 89.0 | 66.5 | 32.4 |
| <PHI +4 (1/16 mm) | 71.8 | 61.2 | 66.1 | 82.4 | 70.5 | 77.4 | 72.0 | 72.6 | 87.0 | 65.7 | 27.9 |
| <PHI +5 (1/32 mm) | 67.7 | 48.9 | 62.9 | 73.7 | 64.4 | 73.5 | 70.9 | 65.3 | 84.8 | 60.4 | 23.8 |
| <PHI +6 (1/64 mm) | 38.7 | 29.4 | 39.3 | 64.9 | 59.1 | 69.2 | 67.2 | 59.6 | 83.1 | 57.4 | 19.2 |
| <PHI +7 (1/128 mm) | 27.3 | 17.2 | 29.7 | 44.4 | 46.6 | 57.6 | 46.3 | 46.9 | 71.3 | 55.1 | 14.5 |
| <PHI +8 (1/256 mm) | 23.9 | 14.4 | 26.1 | 39.7 | 40.2 | 48.9 | 39.6 | 43.0 | 62.7 | 49.1 | 12.7 |
| <PHI +9 (1/512 mm) | 20.8 | 11.9 | 23.7 | 30.9 | 33.0 | 37.4 | 35.7 | 38.7 | 51.7 | 44.6 | 10.6 |
| Gravel | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.6 |
| Sand | 28.2 | 38.8 | 33.9 | 17.6 | 29.5 | 22.6 | 28.0 | 27.4 | 13.0 | 34.3 | 62.5 |
| Silt | 47.9 | 46.8 | 39.9 | 42.7 | 30.3 | 28.4 | 32.4 | 29.6 | 24.3 | 16.6 | 15.2 |
| Clay | 23.9 | 14.4 | 26.1 | 39.7 | 40.2 | 48.9 | 39.6 | 43.0 | 62.7 | 49.1 | 12.7 |
| TOC (%) | 13.88296104 | 10.67311926 | 15.42342326 | 19.37171322 | 18.7492446 | 17.9302392 | 22.3036907 | 25.7421363 | 25.779277 | 38.298344 | 29 |

Notes:
TOC - Total organic carbon
PAS - Philip Analytical Services
RPC - Research and Productivity Lab

**Table B.1: Grain Size Analysis**

| Date Sampled<br>Date Reported<br>Lab | On-site Marsh Station 2<br>Dec 13-01<br>Jan 7-02<br>PAS | On-site Marsh Station 1<br>Dec 13-01<br>Jan 7-02<br>RPC | On-site Marsh Station 2<br>Dec 13-01<br>Jan 7-02<br>RPC | Reference Marsh Station 1<br>Dec 13-01<br>Jan 7-02<br>RPC | Reference Marsh Station 2<br>Dec 13-01<br>Jan 7-02<br>RPC | Reference Marsh Station 1 Sample 2<br>Dec 13-01<br>Jan 7-02<br>PAS | Reference Marsh Station 2 Sample 2<br>Dec 13-01<br>Jan 7-02<br>PAS |
|---|---|---|---|---|---|---|---|
| <PHI -1 (2 mm) | 95.8 | 82.4 | 86.9 | 66.7 | 39.6 | 78.4 | 72.5 |
| <PHI 0 (1 mm) | 89.5 | 73.7 | 78.4 | 55.2 | 32.7 | 63.4 | 60.1 |
| <PHI +1 (1/2 mm) | 76.1 | 58.7 | 64.9 | 38.6 | 23.7 | 43.7 | 40.7 |
| <PHI +2 (1/4 mm) | 54.9 | 38.4 | 45.1 | 25.5 | 16.8 | 28.6 | 26 |
| <PHI +3 (1/8 mm) | 43.6 | 28.4 | 36.1 | 19.9 | 13.7 | 22.2 | 20.1 |
| <PHI +4 (1/16 mm) | 38.6 | 24.1 | 32.2 | 16.7 | 12 | 18.2 | 16 |
| <PHI +5 (1/32 mm) | 33.7 | 20.6 | 27.5 | 13.2 | 9.7 | 14.9 | 13.4 |
| <PHI +6 (1/64 mm) | 28.6 | 17.2 | 22.2 | 10.8 | 7.8 | 12.2 | 10.4 |
| <PHI +7 (1/128 mm) | 22.2 | 12.4 | 15.1 | 7.6 | 5 | 9 | 7.5 |
| <PHI +8 (1/256 mm) | 19.5 | 10.8 | 13.3 | 6.5 | 4.1 | 8 | 6.9 |
| <PHI +9 (1/512 mm) | 15.9 | 8.2 | 10 | 3.8 | 2.1 | 6.3 | 4.8 |
| Gravel | 4.2 | 17.6 | 13.1 | 33.3 | 60.4 | 21.6 | 27.5 |
| Sand | 57.2 | 58.2 | 54.7 | 50 | 27.6 | 60.2 | 56.5 |
| Silt | 19.1 | 13.3 | 18.9 | 10.2 | 7.8 | 10.2 | 9.1 |
| Clay | 19.5 | 10.8 | 13.3 | 6.5 | 4.1 | 8 | 6.9 |
| TOC (%) | 45 | 3.9 | 6.2 | 2.5 | 2.5 | 26 | 27 |

Notes:
TOC - Total organic carbon
PAS - Philip Analytical Services
RPC - Research and Productivity Lab

**Table B.2: Toxicity Tests**

| Sample Number | Test Date | Hyalella Mean % Survival and Standard Deviation | Hyalella Mean Weight and Standard Deviation (mg) | Microtox IC 50 (mg dry sediment/L diluent) |
|---|---|---|---|---|
| Ned's Pond, Sample 1 Station 1 | Nov 29-01 | 100+/- 0<br>98+/- 4.5** | 0.33+/- 0.340<br>0.19+/- 0.038** | ~9860 |
| Ned's Pond, Sample ? Station 3 | Nov 29-01 | 94+/- 8.9 | 0.16+/- 0.013 | >11800 |
| Ned's Pond, Sample 3 Station 5 | Nov 29-01 | 100+/- 0<br>90+/- 7.1** | 0.45+/- 0.351<br>0.16+/- 0.047** | >19600 |
| Pond 2, Sample 1 Station 1 | Nov 29-01 | 96+/- 5.5 | 0.22+/- 0.043 | 1240 (1160-1330) |
| Pond 2, Sample 1 Station 3 | Nov 29-01 | 100+/- 0 | 0.12+/- 0.072 | 4590 (4470-4710) |
| Pond 2, Sample 1 Station 5 | Nov 29-01 | 100+/- 0<br>94+/- 5.5** | 0.33+/- 0.308<br>0.11+/- 0.015** | >15700 |
| Black Duck Pond, Sample 1 | Nov 28-01 | 98+/- 4.5 | 0.18+/- 0.011 | 2560 (1790-3670) |
| Black Duck Pond, Sample 2 Station 3 | Nov 28-01 | 98+/- 4.5 | 0.18+/- 0.007 | 14600 (2080 - >23300) |
| Black Duck Pond, Sample 3 Station 5 | Nov 28-01 | 100+/- 0 | 0.16+/- 0.015 | 5970 (5860-6080) |
| Control Pond 2, Sample 1 Station 1 | Nov 28-01 | 100+/- 0 | 0.20+/- 0.017 | 19500 (6540-58400) |
| Control Pond 2, Sample 2 Station 3 | Nov 28-01 | 100+/- 0 | 0.16+/- 0.007 | 3000 (2290-3920) |
| Control Pond 2, Sample 3 Station 5 | Nov 28-01 | 98+/- 4.5 | 0.17+/- 0.014 | >13900 |
| On-site Marsh, Station 1 Sample 1 | Jan 24-02 | 94 +/- 5.5 | 0.16 +/- 0.015 | 18800 (17100-20600) |
| On-site Marsh, Station 2 Sample 1 | Jan 24-02 | 94 +/- 5.5 | 0.016 +/- 0.028 | 17600 (15900-19400) |
| Reference Marsh, Station 1 Sample 1 | Jan 24-02 | 100+/- 0 | 0.16 +/- 0.015 | 34500 (29100-40900) |
| Reference Marsh, Station 2 Sample 1 | Jan 24-02 | 100+/- 0 | 0.16 +/- 0.013 | 40300 (39100-41400) |
| Lab Control | Nov 28-01 | 100+/- 0 | 0.23+/- 0.017 | |
| Lab Control | Nov 29-01 | 100+/- 0 | 0.15+/- 0.012 | |
| Lab Control | Jan 24-02 | 98 +/- 4.5 | 0.2 +/- 0.042 | |
| | | | | |
| | | | | |

** Several very large amphipods were found at the end of the test . These were larger than normal 2-3 week old juveniles, and thought to have been indigenous to the test sediment and present before test organisms were added. They were omitted from calculations of survival and weight in the second row of results for these 3 treatments. All toxicity testing was completed by the Environment Canada lab in Moncton,NB.

**Table B.3: Sediment Total Petroleum Hydrocarbon Chemistry**

| Sample No. | Units | Date Collected | Date Reported | Lab | Benzene | Toluene | Ethylbenzene | Xylenes | C6-C10 | C11-C20 | C21-C32 | Total TPH | Resemblance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Neds Pond Station 1 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Ned's Pond Station 2 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | 93 | 93 | Lube oil range |
| Ned's Pond Station 3 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | 74 | 74 | Lube oil range |
| Ned's Pond Station 4 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | 65 | 65 | Lube oil range |
| Ned's Pond Station 5 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 1 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 1 (dup) | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 2 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 3 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 4 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | 42 | 42 | Lube oil range |
| Pond 2 Station 5 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | 3.8 | nd | nd | 3.8 | Gasoline range |
| Black Duck Pond Station 1 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond Station 2 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond Station 3 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond Station 4 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond Station 5 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station 1 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station 2 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station3 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station4 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station5 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| On-site Marsh Station1 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | 6.7 | nd | 150 | 160 | Gasoline and lube oil range |
| On-site Marsh Station2 | mg/kg | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | 18 | 34 | 440 | 490 | Gasoline, fuel and lube oil range |
| On-site Marsh Station 1 | mg/kg | Dec 13-01 | Jan 3-02 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| On-site Marsh Station 2 | mg/kg | Dec 13-01 | Jan 3-02 | RPC | nd | nd | nd | nd | nd | nd | nd | 75 | Lube oil range |
| On-site Marsh Station 1 Sample 2 | mg/kg | Dec 13-01 | Dec 27-01 | PAS | nd | nd | nd | nd | nd | 57 | 170 | 227 | Fuel/lube range |
| On-site Marsh Station 2 Sample 2 | mg/kg | Dec 13-01 | Dec 27-01 | PAS | nd | nd | nd | nd | nd | 120 | 340 | 460 | Fuel/lube range |
| Reference Marsh Station 1 | mg/kg | Dec 13-01 | Jan 3-02 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Reference Marsh Station 2 | mg/kg | Dec 13-01 | Jan 3-02 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Reference Marsh Station 1 Sample 2 | mg/kg | Dec 13-01 | Dec 27-01 | PAS | nd | nd | nd | nd | nd | nd | 69 | 69 | Lube oil fraction |
| (dup) | mg/kg | Dec 13-01 | Jan 03-02 | PAS | nd | nd | nd | nd | nd | nd | 45 | 45 | Lube oil range |
| Reference Marsh Station 2 Sample 2 | mg/kg | Dec 13-01 | Dec 27-01 | PAS | nd | nd | nd | nd | nd | nd | 68 | 68 | Lube oil fraction |
| **QA SAMPLES** | | | | | | | | | | | | | |
| Ned's Pond | mg/kg | Jan 15-02 | Jan 22-02 | RPC | < 0.05 | 0.06 | < 0.05 | 0.12 | nd | nd | nd | nd | n/a |
| Ned's Pond | mg/kg | Jan 15-02 | Jan 31-02 | PAS | nd | nd | nd | nd | nd | 110 | 320 | 430 | Fuel/lube range |
| Ned's Pond (Lab revision)* | mg/kg | Jan 21-02 | Jan 28-02 | PAS | nd | nd | nd | nd | nd | 180 | 430 | 610 | Fuel/lube range |
| Ned's Pond | mg/kg | Jan 15-02 | May 14-02 | ECB | nt | nt | nt | nt | nt | 56 | 1240 | 1296 | Lube oil range |
| Pond 2 | mg/kg | Jan 15-02 | Jan 22-02 | RPC | < 0.03 | nd | < 0.03 | nd | nd | 51 | 47 | 98 | Fuel/lube range |
| Pond 2 | mg/kg | Jan 15-02 | Jan 31-02 | PAS | nd | nd | nd | nd | nd | 170 | 390 | 560 | Fuel/lube range |
| Pond 2 | mg/kg | Jan 15-02 | May 14-02 | ECB | nt | nt | nt | nt | nt | 32 | 911 | 943 | Lube oil range |
| Black Duck Pond | mg/kg | Jan 15-02 | Jan 22-02 | RPC | < 0.03 | nd | < 0.03 | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond | mg/kg | Jan 15-02 | Jan 31-02 | PAS | nd | nd | nd | nd | nd | nd | 180 | 180 | Lube oil range |
| Black Duck Pond | mg/kg | Jan 15-02 | May 14-02 | ECB | nt | nt | nt | nt | nt | 26 | 588 | 588 | Lube oil range |
| Control Pond 2 | mg/kg | Jan 15-02 | Jan 22-02 | RPC | < 0.05 | nd | < 0.05 | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 | mg/kg | Jan 15-02 | Jan 31-02 | PAS | nd | nd | nd | nd | nd | nd | 190 | 190 | Lube oil range |
| Control Pond 2 | mg/kg | Jan 15-02 | May 14-02 | ECB | nt | nt | nt | nt | nt | 42 | 1110 | 1152 | Lube oil range |
| RPC EQL | mg/kg | | | | <0.025 | <0.025 | <0.025 | <0.05 | <2.5 | <15 | <15 | <30 | |
| PAS EQL | mg/kg | | | | <0.01 | <0.05 | <0.01 | <0.05 | <2.5 | <25 | <40 | <40 | |
| ECB EQL | mg/kg | | | | | | | | | | | | |
| MOE Sediment Quality Guidelines | mg/kg | | | | | | | | | | | 1500 | |

Notes:
MOE Sediment Quality Guidelines - Ontario Ministry of the Environment. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario.
nd - not detected
n/a - not applicable
EQL - Estimated Limit of Quantification
PAS - Philip Analytical Services
RPC - Research and Productivity Lab
NPM - Ned's Pond Marsh
ECB - Environment Canada Lab, Moncton
QA Samples were a mixture of all of the samples collected in each of the four ponds (i.e. all of Ned's Pond samples were combined to create one mixture, etc.) which were then submitted to three different laboratories for comparison of results
*Due to a possible lab error, the sample extract was reanalysed with similar results identified
The highest standard detection limits that were reported are presented for RPC and PAS (no elevated detection limits due to lab interference are presented)

**Table B.4: Surface Water Total Petroleum Hydrocarbon (TPH) Chemistry**

| Sample No. | Units | Date Collected | Date Reported | Lab | Benzene | Toluene | Ethylbenzene | Xylenes | C6-C10 | C11-C20 | C21-C32 | Total TPH | Resemblance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Neds Pond Station 1 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Ned's Pond Station 2 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Ned's Pond Station 3 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Ned's Pond Station 4 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Ned's Pond Station 5 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 1 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 2 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 3 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 4 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Pond 2 Station 5 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond Station 1 | ug/L | Nov 22-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond Station 2 | ug/L | Nov 22-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond Station 3 | ug/L | Nov 22-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond Station 4 | ug/L | Nov 22-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Black Duck Pond Station 5 | ug/L | Nov 22-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station 1 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station 2 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station 3 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station 4 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| Control Pond 2 Station 5 | ug/L | Nov 21-01 | Dec 11-01 | RPC | nd | nd | nd | nd | nd | nd | nd | nd | n/a |
| RPC EQL | ug/L | | | | <0.1 | <0.1 | <0.1 | <0.1 | <2.5 | <20 | <100 | <100 | |
| CCME (2001) | ug/L | | | | 370 | 2 | 90 | n/a | n/a | n/a | n/a | n/a | - |
| GCDWQ (2001) | ug/L | | | | 5 | 24 | 2.4 | 300 | n/a | n/a | n/a | n/a | - |
| Atlantic PIRI (1999) | ug/L | | | | 5 | 24 | 2.4 | 300 | | | | 1800 | |

CCME (2001) - Canadian Water Quality Guidelines for the Protection of Aquatic Life (freshwater)
GCDWQ (2001) - Guidelines for Canadian Drinking Water Quality
nd - not detected
n/a - not applicable
PAS - Philip Analytical Services
RPC - Research and Productivity Lab

**Table B.5: Sediment PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Detection Limit RPC<br><br><br><br>mg/kg | Detection Limit PAS<br><br><br><br>mg/kg | Detection Limit ECB<br><br><br><br>mg/kg | Ned's Pond Station 1<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Ned's Pond Station 2<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Ned's Pond Station 3<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Ned's Pond Station 4<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 0.0346 | 0.391 | - | 0.01 | 0.05 | 0.05 | 0.01 | 0.01 | 0.01 | 0.01 |
| Perylene | - | - | - | n/a | 0.05 | 0.05 | nt | nt | nt | nt |
| 2-Methylnaphthalene | 0.0202 | 0.201 | - | n/a | 0.05 | 0.05 | nd | nd | nd | nd |
| 1-Methylnaphthalene | - | - | - | 0.01 | 0.05 | 0.05 | nd | nd | nd | nd |
| Acenaphthylene | 0.00587 | 0.128 | - | 0.01 | 0.05 | 0.05 | nd | nd | nd | nd |
| Acenaphthene | 0.00671 | 0.0889 | - | 0.01 | 0.05 | 0.05 | ***0.01*** | ***0.01*** | ***0.01*** | ***0.01*** |
| Fluorene | 0.0212 | 0.144 | 0.19 | 0.01 | 0.05 | 0.05 | 0.01 | 0.02 | 0.01 | 0.01 |
| Phenanthrene | 0.0419 | 0.515 | 0.56 | 0.01 | 0.05 | 0.05 | *0.08* | *0.11* | *0.06* | *0.11* |
| Anthracene | 0.0469 | 0.245 | 0.22 | 0.01 | 0.05 | 0.05 | 0.03 | 0.04 | 0.01 | 0.03 |
| Fluoranthene | 0.111 | 2.355 | 0.75 | 0.01 | 0.05 | 0.05 | *0.14* | *0.16* | 0.09 | *0.17* |
| Pyrene | 0.053 | 0.875 | 0.49 | 0.01 | 0.05 | 0.05 | *0.11* | *0.12* | *0.06* | *0.10* |
| Benzo(a)anthracene | 0.0317 | 0.385 | 0.32 | 0.01 | 0.05 | 0.05 | *0.04* | *0.06* | 0.02 | 0.03 |
| Chrysene | 0.0571 | 0.862 | 0.34 | 0.01 | 0.05 | 0.05 | *0.06* | *0.07* | 0.03 | *0.07* |
| Benzo(b)fluoranthene | - | - | - | 0.01 | 0.05 | 0.05 | 0.05 | 0.60 | 0.02 | 0.08 |
| Benzo(k)fluoranthene | - | - | 0.24 | 0.01 | 0.05 | 0.05 | 0.05 | 0.60 | 0.02 | 0.08 |
| Benzo(a)pyrene | 0.0319 | 0.782 | 0.37 | 0.01 | 0.05 | 0.05 | *0.05* | nd | 0.02 | *0.07* |
| Indeno(1,2,3-cd)pyrene | - | - | 0.20 | 0.01 | 0.05 | 0.05 | 0.06 | nd | 0.03 | 0.04 |
| Dibenz(a,h)anthracene | 0.00622 | 0.135 | 0.06 | 0.01 | 0.05 | 0.05 | nd | nd | *0.01* | *0.05* |
| Benzo(ghi)perylene | - | - | - | 0.01 | 0.05 | 0.05 | 0.06 | nd | 0.04 | 0.03 |

**Table B.5: Sediment PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Ned's Pond Station 5<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Pond 2 Station 1<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Pond 2 Station 2<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Pond 2 Station 2 (Dup)<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Pond 2 Station 3<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Pond 2 Station 3 (Dup)<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Pond 2 Station 4<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Pond 2 Station 5<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 0.0346 | 0.391 | - | 0.01 | nd | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | nd |
| Perylene | - | - | - | nt | nt | nt | nt | nt | nt | nt | nt |
| 2-Methylnaphthalene | 0.0202 | 0.201 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| 1-Methylnaphthalene | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Acenaphthylene | 0.00587 | 0.128 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Acenaphthene | 0.00671 | 0.0889 | - | ***0.01*** | ***0.01*** | ***0.01*** | nd | nd | nd | ***0.01*** | nd |
| Fluorene | 0.0212 | 0.144 | 0.19 | 0.02 | nd | nd | nd | nd | 0.01 | 0.01 | nd |
| Phenanthrene | 0.0419 | 0.515 | 0.56 | *0.07* | 0.02 | ***0.05*** | 0.04 | 0.04 | ***0.07*** | ***0.08*** | 0.02 |
| Anthracene | 0.0469 | 0.245 | 0.22 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | nd | 0.01 | 0.01 |
| Fluoranthene | 0.111 | 2.355 | 0.75 | *0.15* | 0.03 | 0.08 | 0.05 | 0.07 | 0.08 | 0.09 | 0.03 |
| Pyrene | 0.053 | 0.875 | 0.49 | *0.10* | 0.03 | *0.06* | 0.04 | *0.06* | *0.07* | *0.07* | 0.02 |
| Benzo(a)anthracene | 0.0317 | 0.385 | 0.32 | *0.04* | 0.01 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.01 |
| Chrysene | 0.0571 | 0.862 | 0.34 | *0.06* | 0.01 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.02 |
| Benzo(b)fluoranthene | - | - | - | 0.05 | 0.01 | 0.03 | 0.02 | 0.04 | 0.03 | 0.04 | 0.01 |
| Benzo(k)fluoranthene | - | - | 0.24 | 0.05 | 0.01 | 0.03 | 0.02 | 0.04 | 0.03 | 0.04 | 0.01 |
| Benzo(a)pyrene | 0.0319 | 0.782 | 0.37 | *0.07* | nd | nd | nd | nd | 0.03 | 0.02 | nd |
| Indeno(1,2,3-cd)pyrene | - | - | 0.20 | 0.06 | nd | nd | nd | nd | nd | 0.03 | nd |
| Dibenz(a,h)anthracene | 0.00622 | 0.135 | 0.06 | *0.06* | nd | nd | nd | nd | nd | nd | nd |
| Benzo(ghi)perylene | - | - | - | 0.05 | nd | nd | nd | nd | nd | 0.03 | nd |

**Table B.5: Sediment PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Black Duck Pond Station 1<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Black Duck Pond Station 2<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Black Duck Pond Station 3<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Black Duck Pond Station 4<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Black Duck Pond Station 5<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Control Pond 2 Station 1<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 0.0346 | 0.391 | - | 0.01 | 0.01 | nd | nd | 0.01 | 0.01 |
| Perylene | - | - | - | nt | nt | nt | nt | nt | nt |
| 2-Methylnaphthalene | 0.0202 | 0.201 | - | nd | nd | nd | nd | nd | nd |
| 1-Methylnaphthalene | - | - | - | nd | nd | nd | nd | nd | nd |
| Acenaphthylene | 0.00587 | 0.128 | - | *0.01* | nd | nd | nd | nd | nd |
| Acenaphthene | 0.00671 | 0.0889 | - | nd | nd | nd | nd | nd | nd |
| Fluorene | 0.0212 | 0.144 | 0.19 | nd | nd | nd | nd | nd | nd |
| Phenanthrene | 0.0419 | 0.515 | 0.56 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| Anthracene | 0.0469 | 0.245 | 0.22 | nd | nd | nd | nd | nd | nd |
| Fluoranthene | 0.111 | 2.355 | 0.75 | 0.06 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 |
| Pyrene | 0.053 | 0.875 | 0.49 | 0.05 | 0.01 | 0.03 | 0.02 | 0.02 | 0.02 |
| Benzo(a)anthracene | 0.0317 | 0.385 | 0.32 | 0.02 | nd | 0.01 | nd | 0.01 | 0.01 |
| Chrysene | 0.0571 | 0.862 | 0.34 | 0.04 | 0.01 | 0.02 | 0.01 | 0.01 | 0.03 |
| Benzo(b)fluoranthene | - | - | - | 0.04 | 0.01 | 0.03 | 0.01 | 0.02 | 0.02 |
| Benzo(k)fluoranthene | - | - | 0.24 | 0.04 | 0.01 | 0.03 | 0.01 | 0.02 | 0.02 |
| Benzo(a)pyrene | 0.0319 | 0.782 | 0.37 | 0.02 | nd | 0.01 | nd | nd | 0.01 |
| Indeno(1,2,3-cd)pyrene | - | - | 0.20 | 0.07 | nd | 0.04 | nd | nd | 0.04 |
| Dibenz(a,h)anthracene | 0.00622 | 0.135 | 0.06 | *0.01* | nd | nd | nd | nd | *0.01* |
| Benzo(ghi)perylene | - | - | - | 0.06 | nd | 0.04 | nd | nd | 0.03 |

**Table B.5: Sediment PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br>mg/kg | CCME (2001) PEL<br>mg/kg | MOE (1993) Lowest Effect Level<br>mg/kg | Control Pond 2 Station 2<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Control Pond 2 Station 3<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Control Pond 2 Station 4<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Control Pond 2 Station 5<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | On-site Marsh Station 1<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | On-site Marsh Station 2<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 0.0346 | 0.391 | - | 0.01 | 0.01 | 0.01 | 0.02 | ***0.05*** | nd |
| Perylene | - | - | - | nt | nt | nt | nt | nt | nt |
| 2-Methylnaphthalene | 0.0202 | 0.201 | - | nd | nd | nd | nd | nd | nd |
| 1-Methylnaphthalene | - | - | - | nd | nd | nd | nd | nd | nd |
| Acenaphthylene | 0.00587 | 0.128 | - | nd | nd | nd | nd | nd | nd |
| Acenaphthene | 0.00671 | 0.0889 | - | nd | nd | nd | nd | **0.10** | nd |
| Fluorene | 0.0212 | 0.144 | 0.19 | nd | nd | nd | nd | ***0.14*** | nd |
| Phenanthrene | 0.0419 | 0.515 | 0.56 | 0.01 | 0.01 | 0.01 | 0.04 | **0.87** | ***0.20*** |
| Anthracene | 0.0469 | 0.245 | 0.22 | nd | nd | nd | 0.01 | ***0.23*** | 0.04 |
| Fluoranthene | 0.111 | 2.355 | 0.75 | 0.02 | 0.03 | 0.02 | 0.07 | ***0.91*** | ***0.25*** |
| Pyrene | 0.053 | 0.875 | 0.49 | 0.02 | 0.02 | 0.01 | 0.05 | ***0.69*** | ***0.22*** |
| Benzo(a)anthracene | 0.0317 | 0.385 | 0.32 | nd | 0.01 | 0.01 | 0.02 | ***0.28*** | ***0.09*** |
| Chrysene | 0.0571 | 0.862 | 0.34 | 0.01 | nd | 0.01 | 0.04 | ***0.44*** | ***0.14*** |
| Benzo(b)fluoranthene | - | - | - | 0.01 | 0.03 | 0.02 | 0.07 | 0.26 | 0.09 |
| Benzo(k)fluoranthene | - | - | 0.24 | 0.01 | 0.03 | 0.02 | 0.07 | 0.26 | 0.09 |
| Benzo(a)pyrene | 0.0319 | 0.782 | 0.37 | 0.01 | 0.02 | 0.02 | ***0.04*** | ***0.28*** | nd |
| Indeno(1,2,3-cd)pyrene | - | - | 0.20 | nd | 0.07 | 0.05 | 0.17 | 0.19 | nd |
| Dibenz(a,h)anthracene | 0.00622 | 0.135 | 0.06 | nd | nd | nd | ***0.02*** | nd | nd |
| Benzo(ghi)perylene | - | - | - | nd | 0.04 | 0.04 | 0.13 | 0.13 | nd |

**Table B.5: Sediment PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Control Pond 2 Station 2<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Control Pond 2 Station 3<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Control Pond 2 Station 4<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | Control Pond 2 Station 5<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | On-site Marsh Station 1<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg | On-site Marsh Station 2<br>Nov 20-01<br>Jan 22-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 0.0346 | 0.391 | - | 0.01 | 0.01 | 0.01 | 0.02 | ***0.05*** | nd |
| Perylene | - | - | - | nt | nt | nt | nt | nt | nt |
| 2-Methylnaphthalene | 0.0202 | 0.201 | - | nd | nd | nd | nd | nd | nd |
| 1-Methylnaphthalene | - | - | - | nd | nd | nd | nd | nd | nd |
| Acenaphthylene | 0.00587 | 0.128 | - | nd | nd | nd | nd | nd | nd |
| Acenaphthene | 0.00671 | 0.0889 | - | nd | nd | nd | nd | ***0.10*** | nd |
| Fluorene | 0.0212 | 0.144 | 0.19 | nd | nd | nd | nd | ***0.14*** | nd |
| Phenanthrene | 0.0419 | 0.515 | 0.56 | 0.01 | 0.01 | 0.01 | 0.04 | ***0.87*** | ***0.20*** |
| Anthracene | 0.0469 | 0.245 | 0.22 | nd | nd | nd | 0.01 | ***0.23*** | 0.04 |
| Fluoranthene | 0.111 | 2.355 | 0.75 | 0.02 | 0.03 | 0.02 | 0.07 | ***0.91*** | ***0.25*** |
| Pyrene | 0.053 | 0.875 | 0.49 | 0.02 | 0.02 | 0.01 | 0.05 | ***0.69*** | ***0.22*** |
| Benzo(a)anthracene | 0.0317 | 0.385 | 0.32 | nd | 0.01 | 0.01 | 0.02 | ***0.28*** | ***0.09*** |
| Chrysene | 0.0571 | 0.862 | 0.34 | 0.01 | nd | 0.01 | 0.04 | ***0.44*** | ***0.14*** |
| Benzo(b)fluoranthene | - | - | - | 0.01 | 0.03 | 0.02 | 0.07 | 0.26 | 0.09 |
| Benzo(k)fluoranthene | - | - | 0.24 | 0.01 | 0.03 | 0.02 | 0.07 | 0.26 | 0.09 |
| Benzo(a)pyrene | 0.0319 | 0.782 | 0.37 | 0.01 | 0.02 | 0.02 | ***0.04*** | ***0.28*** | nd |
| Indeno(1,2,3-cd)pyrene | - | - | 0.20 | nd | 0.07 | 0.05 | 0.17 | 0.19 | nd |
| Dibenz(a,h)anthracene | 0.00622 | 0.135 | 0.06 | nd | nd | nd | ***0.02*** | nd | nd |
| Benzo(ghi)perylene | - | - | - | nd | 0.04 | 0.04 | 0.13 | 0.13 | nd |

**Table B.5: Sediment PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | On-site Marsh Station 1<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | On-site Marsh Station 2<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | On-site Marsh Station 1 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg | On-site Marsh Station 2 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg | Reference Marsh Station 1<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Reference Marsh Station 2<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 0.0346 | 0.391 | - | 0.01 | nd | nd | nd | nd | nd |
| Perylene | - | - | - | nt | nt | 0.23 | 0.40 | nt | nt |
| 2-Methylnaphthalene | 0.0202 | 0.201 | - | nd | nd | nd | nd | nd | nd |
| 1-Methylnaphthalene | - | - | - | nd | nd | nd | nd | nd | nd |
| Acenaphthylene | 0.00587 | 0.128 | - | nd | nd | nd | nd | nd | nd |
| Acenaphthene | 0.00671 | 0.0889 | - | nd | nd | nd | nd | nd | nd |
| Fluorene | 0.0212 | 0.144 | 0.19 | 0.01 | *0.03* | nd | nd | nd | nd |
| Phenanthrene | 0.0419 | 0.515 | 0.56 | 0.03 | 0.08 | nd | nd | nd | nd |
| Anthracene | 0.0469 | 0.245 | 0.22 | nd | 0.01 | nd | nd | nd | nd |
| Fluoranthene | 0.111 | 2.355 | 0.75 | 0.02 | 0.03 | nd | nd | nd | 0.01 |
| Pyrene | 0.053 | 0.875 | 0.49 | 0.01 | 0.02 | nd | nd | nd | 0.01 |
| Benzo(a)anthracene | 0.0317 | 0.385 | 0.32 | 0.01 | 0.02 | nd | nd | nd | nd |
| Chrysene | 0.0571 | 0.862 | 0.34 | 0.01 | 0.01 | nd | nd | nd | nd |
| Benzo(b)fluoranthene | - | - | - | 0.01 | 0.01 | nd | nd | nd | 0.01 |
| Benzo(k)fluoranthene | - | - | 0.24 | 0.01 | 0.01 | nd | nd | nd | 0.01 |
| Benzo(a)pyrene | 0.0319 | 0.782 | 0.37 | 0.01 | 0.01 | nd | nd | nd | nd |
| Indeno(1,2,3-cd)pyrene | - | - | 0.20 | nd | 0.01 | nd | nd | nd | nd |
| Dibenz(a,h)anthracene | 0.00622 | 0.135 | 0.06 | nd | nd | nd | nd | nd | nd |
| Benzo(ghi)perylene | - | - | - | nd | 0.01 | nd | nd | nd | nd |

**Table B.5: Sediment PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Reference Marsh Station 1 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg | Reference Marsh Station 1 Sample 2 (Dup)<br>Dec 13-01<br>Jan 03-02<br>PAS<br>mg/kg | Reference Marsh Station 2 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg | Neds Pond (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Neds Pond (QA Sample)<br>Jan 18-02<br>Jan 28-02<br>PAS<br>mg/kg | Neds Pond (QA Sample)<br>Jan 15-02<br>Jan 31-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 0.0346 | 0.391 | - | nd | nd | nd | nd | nd | 0.01 |
| Perylene | - | - | - | nd | nd | nd | 4.00 | 2.90 | nt |
| 2-Methylnaphthalene | 0.0202 | 0.201 | - | nd | nd | nd | nd | nd | nd |
| 1-Methylnaphthalene | - | - | - | nd | nd | nd | nd | nd | nd |
| Acenaphthylene | 0.00587 | 0.128 | - | nd | nd | nd | nd | nd | nd |
| Acenaphthene | 0.00671 | 0.0889 | - | nd | nd | nd | nd | nd | ***0.01*** |
| Fluorene | 0.0212 | 0.144 | 0.19 | nd | nd | nd | nd | nd | 0.01 |
| Phenanthrene | 0.0419 | 0.515 | 0.56 | nd | nd | nd | nd | nd | ***0.09*** |
| Anthracene | 0.0469 | 0.245 | 0.22 | nd | nd | nd | nd | nd | 0.02 |
| Fluoranthene | 0.111 | 2.355 | 0.75 | nd | nd | nd | nd | nd | ***0.14*** |
| Pyrene | 0.053 | 0.875 | 0.49 | nd | nd | nd | nd | nd | ***0.11*** |
| Benzo(a)anthracene | 0.0317 | 0.385 | 0.32 | nd | nd | nd | nd | nd | ***0.05*** |
| Chrysene | 0.0571 | 0.862 | 0.34 | nd | nd | nd | nd | nd | ***0.06*** |
| Benzo(b)fluoranthene | - | - | - | nd | nd | nd | nd | nd | 0.06 |
| Benzo(k)fluoranthene | - | - | 0.24 | nd | nd | nd | nd | nd | 0.06 |
| Benzo(a)pyrene | 0.0319 | 0.782 | 0.37 | nd | nd | nd | nd | nd | ***0.06*** |
| Indeno(1,2,3-cd)pyrene | - | - | 0.20 | nd | nd | nd | nd | nd | 0.04 |
| Dibenz(a,h)anthracene | 0.00622 | 0.135 | 0.06 | nd | nd | nd | nd | nd | ***0.01*** |
| Benzo(ghi)perylene | - | - | - | nd | nd | nd | nd | nd | 0.05 |

**Table B.5: Sediment PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | Neds Pond (QA Sample)<br>Jan 15-02<br>June 4-02<br>ECB<br>mg/kg | Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 31-02<br>RPC<br>mg/kg | Pond 2 (QA Sample)<br>Jan 15-02<br>June 4-02<br>ECB<br>mg/kg | Black Duck Pond (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Black Duck Pond (QA Sample)<br>Jan 15-02<br>Jan 31-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|
| Naphthalene | 0.0346 | 0.391 | 0.09 | nd | nd | 0.09 | nd | 0.01 |
| Perylene | - | - | nt | 5.00 | nt | nt | 10.00 | nt |
| 2-Methylnaphthalene | 0.0202 | 0.201 | nt | nd | nd | nt | nd | nd |
| 1-Methylnaphthalene | - | - | nt | nd | nd | nt | nd | nd |
| Acenaphthylene | 0.00587 | 0.128 | nd | nd | nd | nd | nd | nd |
| Acenaphthene | 0.00671 | 0.0889 | nd | nd | nd | nd | nd | nd |
| Fluorene | 0.0212 | 0.144 | 0.01 | nd | 0.01 | 0.01 | nd | nd |
| Phenanthrene | 0.0419 | 0.515 | 0.04 | nd | 0.04 | 0.03 | nd | 0.03 |
| Anthracene | 0.0469 | 0.245 | 0.01 | nd | 0.01 | nd | nd | nd |
| Fluoranthene | 0.111 | 2.355 | 0.06 | nd | 0.05 | 0.04 | nd | 0.05 |
| Pyrene | 0.053 | 0.875 | 0.04 | nd | 0.04 | 0.02 | nd | 0.04 |
| Benzo(a)anthracene | 0.0317 | 0.385 | 0.02 | nd | 0.02 | 0.01 | nd | 0.02 |
| Chrysene | 0.0571 | 0.862 | 0.03 | nd | 0.02 | 0.02 | nd | 0.03 |
| Benzo(b)fluoranthene | - | - | 0.03 | nd | 0.02 | 0.02 | nd | 0.05 |
| Benzo(k)fluoranthene | - | - | 0.02 | nd | 0.02 | 0.02 | nd | 0.05 |
| Benzo(a)pyrene | 0.0319 | 0.782 | nd | nd | 0.03 | nd | nd | 0.03 |
| Indeno(1,2,3-cd)pyrene | - | - | 0.03 | nd | 0.01 | 0.02 | nd | 0.05 |
| Dibenz(a,h)anthracene | 0.00622 | 0.135 | nd | nd | nd | nd | nd | 0.01 |
| Benzo(ghi)perylene | - | - | 0.02 | nd | 0.02 | 0.01 | nd | 0.05 |

**Table B.5: Sediment PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | Black Duck Pond (QA Sample)<br>Jan 15-02<br>June 4-02<br>ECB<br>mg/kg | Control Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Control Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 31-02<br>RPC<br>mg/kg | Control Pond 2 (QA Sample)<br>Jan 15-02<br>June 4-02<br>ECB<br>mg/kg |
|---|---|---|---|---|---|---|
| Naphthalene | 0.0346 | 0.391 | 0.08 | nd | nd | *0.11* |
| Perylene | - | - | nt | 4.70 | nt | nt |
| 2-Methylnaphthalene | 0.0202 | 0.201 | nt | nd | nd | nt |
| 1-Methylnaphthalene | - | - | nt | nd | nd | nt |
| Acenaphthylene | 0.00587 | 0.128 | nd | nd | nd | nd |
| Acenaphthene | 0.00671 | 0.0889 | nd | nd | nd | nd |
| Fluorene | 0.0212 | 0.144 | nd | nd | nd | 0.01 |
| Phenanthrene | 0.0419 | 0.515 | 0.01 | nd | 0.02 | 0.01 |
| Anthracene | 0.0469 | 0.245 | nd | nd | nd | nd |
| Fluoranthene | 0.111 | 2.355 | 0.03 | nd | 0.04 | 0.02 |
| Pyrene | 0.053 | 0.875 | 0.02 | nd | 0.02 | 0.01 |
| Benzo(a)anthracene | 0.0317 | 0.385 | 0.01 | nd | 0.01 | 0.01 |
| Chrysene | 0.0571 | 0.862 | 0.02 | nd | 0.02 | 0.01 |
| Benzo(b)fluoranthene | - | - | 0.03 | nd | 0.03 | 0.03 |
| Benzo(k)fluoranthene | - | - | 0.02 | nd | 0.03 | 0.02 |
| Benzo(a)pyrene | 0.0319 | 0.782 | nd | nd | 0.01 | nd |
| Indeno(1,2,3-cd)pyrene | - | - | 0.04 | nd | 0.05 | 0.04 |
| Dibenz(a,h)anthracene | 0.00622 | 0.135 | nd | nd | nd | nd |
| Benzo(ghi)perylene | - | - | 0.03 | nd | 0.03 | 0.03 |

Notes:
CCME ISQG - CCME (2001) Canadian Sediment Quality Guidelines for the Protection of Aquatic Life - Interim Sedime nt Quality Guidelines (Freshwater)
PEL - Probable Effects Level
Highlighted and italicized values exceed CCME ISQG
Shaded and highlighted values exceed CCME PEL
MOE (1993) - Ontario Ministry of the Environment. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario
nd - not detected
n/a - not applicable
nt - not tested
PAS - Philip Analytical Services
RPC - Research and Productivity Lab
ECB - Environment Canada Lab, Moncton
Dup - duplicate sample
QA Samples were a mixture of all of the samples collected in each of the four ponds (i.e. all of Ned's Pond samples were combined to create one mixture, etc.) which were then submitted to three different laboratories for comparison of results
The highest standard detection limits that were reported are presented for RPC and PAS (no elevated detection limits due to lab interference are presented)

**Table B.6: Surface Water PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001)<br><br><br><br>ug/L | GCDWQ (2001)<br><br><br><br>ug/L | Detection Limit<br>RPC<br><br><br>ug/L | Neds Pond<br>Station 1<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Ned's Pond<br>Station 2<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Ned's Pond<br>Station 3<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Ned's Pond<br>Station 4<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Ned's Pond<br>Station 5<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Pond 2<br>Station 1<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Pond 2<br>Station 2<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Pond 2<br>Station 3<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Pond 2<br>Station 4<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Pond 2<br>Station 5<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 1.1 | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Perylene | - | - | not tested | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 2-Methylnaphthalene | - | - | not tested | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| 1-Methylnaphthalene | - | - | not tested | nt | nt | nt | nt | nt | nt | nt | nt | nt | nt |
| Acenaphthylene | - | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Acenaphthene | 5.8 | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Fluorene | 3 | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Phenanthrene | 0.4 | - | 0.01 | nd | nd | nd | nd | nd | nd | 0.03 | nd | nd | nd |
| Anthracene | 0.012 | - | 0.01 | nd | nd | nd | nd | nd | nd | 0.01 | nd | nd | nd |
| Fluoranthene | 0.04 | - | 0.01 | nd | nd | nd | nd | nd | nd | 0.01 | nd | nd | nd |
| Pyrene | 0.025 | - | 0.01 | nd | nd | nd | nd | nd | nd | 0.02 | nd | nd | nd |
| Benzo(a)anthracene | 0.018 | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Chrysene | - | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Benzo(b)fluoranthene | - | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Benzo(k)fluoranthene | - | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Benzo(a)pyrene | 0.015 | 0.01 | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Indeno(1,2,3-cd)pyrene | - | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Dibenz(a,h)anthracene | - | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Benzo(ghi)perylene | - | - | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |

**Table B.6: Surface Water PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001)<br><br><br><br>ug/L | GCDWQ (2001)<br><br><br><br>ug/L | Black Duck Pond<br>Station 1<br>Nov 22-01<br>Jan 22-02<br>RPC<br>ug/L | Black Duck Pond<br>Station 2<br>Nov 22-01<br>Jan 22-02<br>RPC<br>ug/L | Black Duck Pond<br>Station 3<br>Nov 22-01<br>Jan 22-02<br>RPC<br>ug/L | Black Duck Pond<br>Station 4<br>Nov 22-01<br>Jan 22-02<br>RPC<br>ug/L | Black Duck Pond<br>Station 5<br>Nov 22-01<br>Jan 22-02<br>RPC<br>ug/L | Control Pond 2 Station 1<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Control Pond 2 Station 2<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L |
|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 1.1 | - | nd | nd | 0.01 | nd | 0.01 | nd | nd |
| Perylene | - | - | nt | nt | nt | nt | nt | nt | nt |
| 2-Methylnaphthalene | - | - | nt | nt | nt | nt | nt | nt | nt |
| 1-Methylnaphthalene | - | - | nt | nt | nt | nt | nt | nt | nt |
| Acenaphthylene | - | - | nt | nd | nd | nd | nd | nt | nt |
| Acenaphthene | 5.8 | - | nd | nd | nd | nd | nd | nd | nd |
| Fluorene | 3 | - | nd | nd | nd | nd | nd | nd | nd |
| Phenanthrene | 0.4 | - | nd | nd | nd | nd | nd | nd | nd |
| Anthracene | 0.012 | - | nd | nd | nd | nd | nd | nd | nd |
| Fluoranthene | 0.04 | - | nd | nd | nd | nd | nd | nd | nd |
| Pyrene | 0.025 | - | nd | nd | nd | nd | nd | nd | nd |
| Benzo(a)anthracene | 0.018 | - | nd | nd | nd | nd | nd | nd | nd |
| Chrysene | - | - | nd | nd | nd | nd | nd | nd | nd |
| Benzo(b)fluoranthene | - | - | nd | nd | nd | nd | nd | nd | nd |
| Benzo(k)fluoranthene | - | - | nd | nd | nd | nd | nd | nd | nd |
| Benzo(a)pyrene | 0.015 | 0.01 | nd | nd | nd | nd | nd | nd | nd |
| Indeno(1,2,3-cd)pyrene | - | - | nd | nd | nd | nd | nd | nd | nd |
| Dibenz(a,h)anthracene | - | - | nd | nd | nd | nd | nd | nd | nd |
| Benzo(ghi)perylene | - | - | nd | nd | nd | nd | nd | nd | nd |

**Table B.6: Surface Water PAH Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001)<br><br><br><br>ug/L | GCDWQ (2001)<br><br><br><br>ug/L | Control Pond 2 Station 3<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Control Pond 2 Station 4<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L | Control Pond 2 Station 5<br>Nov 21-01<br>Jan 22-02<br>RPC<br>ug/L |
|---|---|---|---|---|---|
| Naphthalene | 1.1 | - | nd | 0.01 | nd |
| Perylene | - | - | nt | nt | nt |
| 2-Methylnaphthalene | - | - | nt | nt | nt |
| 1-Methylnaphthalene | - | - | nt | nt | nt |
| Acenaphthylene | - | - | nt | nt | nt |
| Acenaphthene | 5.8 | - | nd | nd | nd |
| Flucrene | 3 | - | nd | nd | nd |
| Phenanthrene | 0.4 | - | nd | nd | nd |
| Anthracene | 0.012 | - | nd | nd | nd |
| Fluoranthene | 0.04 | - | nd | nd | nd |
| Pyrene | 0.025 | - | nd | nd | nd |
| Benzo(a)anthracene | 0.018 | - | nd | nd | nd |
| Chrysene | - | - | nd | nd | nd |
| Benzo(b)fluoranthene | - | - | nd | nd | nd |
| Benzo(k)fluoranthene | - | - | nd | nd | nd |
| Benzo(a)pyrene | 0.015 | 0.01 | nd | nd | nd |
| Indeno(1,2,3-cd)pyrene | - | - | nd | nd | nd |
| Dibenz(a,h)anthracene | - | - | nd | nd | nd |
| Benzo(ghi)perylene | - | - | nd | nd | nd |

Notes:
CCME (2001) - Canadian Water Quality Guidelines for the Protection of Aquatic Life (freshwater)
GCDWQ (2001) - Guidelines for Canadian Drinking Water Quality
nd - not detected
n/a - not applicable
nt - not tested
RPC - Research and Productivity Lab

**Table B.7: Fish PAH Chemistry**

| Date Sampled<br>Date Reported<br>Lab<br>Units | Detection Limit<br>RPC<br>mg/kg | Ned's Pond Carcass 1<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Ned's Pond Carcass 2<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Ned's Pond Carcass 3<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Ned's Pond Fillet 1<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Ned's Pond Fillet 1 (Dup)<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Ned's Pond Fillet 2<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Ned's Pond Fillet 3<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Pond 2 Carcass 1<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Pond 2 Fillet 1<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg | Black Duck Pond Carcass 1<br>Dec 13-01<br>Jan 22-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | 0.01 | 0.02 | 0.03 | 0.04 | 0.02 | 0.04 | 0.03 | 0.03 | 0.03 | 0.04 | 0.02 |
| Acenaphthylene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Acenaphthene | 0.01 | 0.01 | nd | 0.01 | nd | nd | nd | nd | nd | nd | nd |
| Fluorene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Phenanthrene | 0.01 | nd | 0.01 | nd | nd | nd | nd | nd | nd | nd | 0.01 |
| Anthracene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Fluoranthene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Pyrene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Benzo(a)anthracene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Chrysene/Triphenylene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Benzo(b+k)fluoranthene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Benzo(e)pyrene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Benzo(a)pyrene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Indeno(1,2,3-cd)pyrene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Benzo(g,h,i)perylene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Dibenz(a,h)anthracene | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |

**Table B.7: Fish PAH Chemistr**

| Date Sampled | Black Duck Pond Fillet 1 Dec 13-01 | Control Pond 2 Carcass 1 Dec 13-01 | Control Pond 2 Carcass 2 Dec 13-01 | Control Pond 2 Fillet 1 Dec 13-01 | Control Pond 2 Fillet 2 Dec 13-01 |
|---|---|---|---|---|---|
| Date Reported | Jan 22-02 | Jan 22-02 | Jan 22-02 | Jan 22-02 | Jan 22-02 |
| Lab | RPC | RPC | RPC | RPC | RPC |
| Units | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| Naphthalene | 0.04 | 0.02 | 0.02 | nd | 0.04 |
| Acenaphthylene | nd | nd | nd | nd | nd |
| Acenaphthene | nd | nd | nd | nd | nd |
| Fluorene | nd | nd | nd | nd | nd |
| Phenanthrene | nd | nd | nd | nd | nd |
| Anthracene | nd | nd | nd | nd | nd |
| Fluoranthene | nd | nd | nd | nd | nd |
| Pyrene | nd | nd | nd | nd | nd |
| Benzo(a)anthracene | nd | nd | nd | nd | nd |
| Chrysene/Triphenylene | nd | nd | nd | nd | nd |
| Benzo(b+k)fluoranthene | nd | nd | nd | nd | nd |
| Benzo(e)pyrene | nd | nd | nd | nd | nd |
| Benzo(a)pyrene | nd | nd | nd | nd | nd |
| Indeno(1,2,3-cd)pyrene | nd | nd | nd | nd | nd |
| Benzo(g,h,i)perylene | nd | nd | nd | nd | nd |
| Dibenz(a,h)anthracene | nd | nd | nd | nd | nd |

Notes:
nd - not detected
n/a - not applicable
RPC - Research and Productivity Lab
Dup - duplicate sample

**Table B.8: Sediment Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Detection Limit RPC<br><br><br><br>mg/kg | Detection Limit PAS<br><br><br><br>mg/kg | Detection Limit ECB<br><br><br><br>mg/kg | Neds Pond Station 1<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Neds Pond Station 2<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Neds Pond Station 3<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Neds Pond Station 4<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Neds Pond Station 5<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Pond 2 Station 1<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alpha-BHC | - | - | 0.006 | 0.03 | 0.002 | 0.003 | nd | nd | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.00094 | 0.00138 | 0.003 | 0.03 | 0.002 | 0.003 | nd | nd | nd | nd | nd | nd |
| Heptachlor | - | - | 0.0003 (no effect) | 0.03 | 0.002 | | nd | nd | nd | nd | nd | nd |
| Aldrin | - | - | 0.002 | 0.03 | 0.002 | 0.003 | nd | nd | nd | nd | nd | nd |
| Heptachlor Epoxide | 0.0006 | 0.00274 | 0.005 | 0.03 | 0.002 | 0.003 | nd | nd | nd | nd | nd | nd |
| Alpha-Endosulfan | - | - | - | 0.03 | 0.004 | 0.003 | nd | nd | nd | nd | nd | nd |
| Para-Para DDE | 0.00142 | 0.00675 | 0.005 | 0.03 | 0.002 | 0.003 | nd | nd | nd | nd | nd | nd |
| Endrin | 0.00267 | 0.0624 | 0.003 | 0.03 | 0.004 | 0.003 | nd | nd | nd | nd | nd | nd |
| Beta-Endosulfan | - | - | - | 0.03 | 0.004 | 0.003 | nd | nd | nd | nd | nd | nd |
| Para-Para DDD | 0.00354 | 0.00651 | 0.008 | 0.03 | 0.004 | 0.003 | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDT | 0.00119 | 0.00477 | 0.004 | not tested | 0.004 | 0.003 | nd | nd | nd | nd | nd | nd |
| Para-Para DDT | 0.00119 | 0.00477 | 0.004 | 0.03 | 0.004 | 0.003 | nd | nd | nd | nd | nd | nd |
| Mirex | - | - | 0.007 | not tested | 0.004 | 0.003 | nd | nd | nd | nd | nd | nd |
| Chlordane | 0.0045 | 0.00887 | 0.007 | not tested | not tested | not tested | nd | nd | nd | nd | nd | nd |
| Dieldrin | 0.00285 | 0.00667 | 0.002 | 0.03 | 0.002 | 0.003 | nd | nd | nd | nd | nd | nd |
| Methoxychlor | - | - | - | 0.03 | 0.04 | 0.003 | nd | nd | nd | nd | nd | nd |
| Hexachlorobenzene | - | - | 0.02 | not tested | not tested | not tested | nd | nd | nd | nd | nd | nd |
| Beta-BHC | - | - | 0.006 | 0.03 | 0.002 | not tested | nd | nd | nd | nd | nd | nd |
| Delta-BHC | - | - | - | 0.03 | 0.002 | not tested | nd | nd | nd | nd | nd | nd |
| Endrin Aldehyde | - | - | - | 0.03 | 0.01 | not tested | nd | nd | nd | nd | nd | nd |
| Endrin Ketone | - | - | - | 0.03 | 0.004 | not tested | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDD | 0.00354 | 0.00651 | - | not tested | not tested | 0.003 | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDE | 0.00142 | 0.00675 | - | not tested | not tested | 0.003 | nd | nd | nd | nd | nd | nd |
| Toxaphene | 0.0001 | - | - | not tested | 0.3 | not tested | nd | nd | nd | nd | nd | nd |
| Endosulfan Sulfate | - | - | - | 0.03 | 0.004 | not tested | nd | nd | nd | nd | nd | nd |
| 2-Chloronaphthalene | - | - | - | not tested | not tested | not tested | nd | nd | nd | nd | nd | nd |
| Alpha-chlordane | | | | not tested | 0.002 | 0.003 | nt | nt | nt | nt | nt | nt |
| Gamma-chlordane | | | | not tested | 0.002 | 0.003 | nt | nt | nt | nt | nt | nt |
| PCBs | 0.0341 | 0.277 | 0.06 (1254) | 0.5 | 0.05 | 0.01 | nd | nd | nd | nd | nd | nd |

**Table B.8: Sediment Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001)<br>ISQG<br>mg/kg | CCME (2001)<br>PEL<br>mg/kg | MOE (1993)<br>Lowest<br>Effect<br>Level<br>mg/kg | Pond 2 Station 2<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Pond 2 Station 3<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Pond 2 Station 4<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Pond 2 Station 5<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Black Duck Pond<br>Station 1<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Black Duck Pond<br>Station 2<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Black Duck Pond<br>Station 3<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Black Duck Pond<br>Station 4<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alpha-BHC | - | - | 0.006 | nd | nd | nd | nd | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.00094 | 0.00136 | 0.003 | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor | - | - | 0.0003 (no effect) | nd | nd | nd | nd | nd | nd | nd | nd |
| Aldrin | - | - | 0.002 | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor Epoxide | 0.0006 | 0.00274 | 0.005 | nd | nd | nd | nd | nd | nd | nd | nd |
| Alpha-Endosulfan | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDE | 0.00142 | 0.00675 | 0.005 | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin | 0.00267 | 0.0624 | 0.003 | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-Endosulfan | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDD | 0.00354 | 0.00851 | 0.008 | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd | nd | nd | nd | nd |
| Mirex | - | - | 0.007 | nd | nd | nd | nd | nd | nd | nd | nd |
| Chlordane | 0.0045 | 0.00887 | 0.007 | nd | nd | nd | nd | nd | nd | nd | nd |
| Dieldrin | 0.00285 | 0.00667 | 0.002 | nd | nd | nd | nd | nd | nd | nd | nd |
| Methoxychlor | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Hexachlorobenzene | - | - | 0.02 | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-BHC | - | - | 0.006 | nd | nd | nd | nd | nd | nd | nd | nd |
| Delta-BHC | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Aldehyde | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Ketone | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDD | 0.00354 | 0.00851 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDE | 0.00142 | 0.00675 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Toxaphene | 0.0001 | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Endosulfan Sulfate | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| 2-Chloronaphthalene | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Alpha-chlordane | | | | nt | nt | nt | nt | nt | nt | nt | nt |
| Gamma-chlordane | | | | nt | nt | nt | nt | nt | nt | nt | nt |
| PCBs | 0.0341 | 0.277 | 0.06 (1254) | nd | nd | nd | nd | nd | nd | nd | nd |

**Table B.8: Sediment Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Black Duck Pond Station 5<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Control Pond 2 Station 1<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Control Pond 2 Station 2<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Control Pond 2 Station 3<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Control Pond 2 Station 4<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | Control Pond 2 Station 5<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | On-site Marsh Station 1<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg | On-site Marsh Station 2<br>Nov 20-01<br>Jan 10-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alpha-BHC | - | - | 0.006 | nd | nd | nd | nd | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.00094 | 0.00136 | 0.003 | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor | - | - | 0.0003 (no effect) | nd | nd | nd | nd | nd | nd | nd | nd |
| Aldrin | - | - | 0.002 | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor Epoxide | 0.0006 | 0.00274 | 0.005 | nd | nd | nd | nd | nd | nd | nd | nd |
| Alpha-Endosulfan | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDE | 0.00142 | 0.00675 | 0.005 | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin | 0.00267 | 0.0624 | 0.003 | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-Endosulfan | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDD | 0.00354 | 0.00651 | 0.008 | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd | nd | nd | nd | nd |
| Mirex | - | - | 0.007 | nd | nd | nd | nd | nd | nd | nd | nd |
| Chlordane | 0.0045 | 0.00887 | 0.007 | nd | nd | nd | nd | nd | nd | nd | nd |
| Dieldrin | 0.00285 | 0.00667 | 0.002 | nd | nd | nd | nd | nd | nd | nd | nd |
| Methoxychlor | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Hexachlorobenzene | - | - | 0.02 | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-BHC | - | - | 0.006 | nd | nd | nd | nd | nd | nd | nd | nd |
| Delta-BHC | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Aldehyde | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Ketone | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDD | 0.00354 | 0.00651 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDE | 0.00142 | 0.00675 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Toxaphene | 0.0001 | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Endosulfan Sulfate | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| 2-Chloronaphthalene | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Alpha-chlordane | | | | nt | nt | nt | nt | nt | nt | nt | nt |
| Gamma-chlordane | | | | nt | nt | nt | nt | nt | nt | nt | nt |
| PCBs | 0.0341 | 0.277 | 0.06 (1254) | nd | nd | nd | nd | nd | nd | nd | nd |

**Table B.6: Sediment Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001)<br>ISQG<br>mg/kg | CCME (2001)<br>PEL<br>mg/kg | MOE (1993)<br>Lowest<br>Effect<br>Level<br>mg/kg | On-site Marsh<br>Station 1<br>Dec 13-01<br>Jan 7-02<br>PAS<br>mg/kg | On-site Marsh Station 2<br>Dec 13-01<br>Jan 7-02<br>PAS<br>mg/kg | On-site Marsh<br>Station 1<br>Dec 13-01<br>Jan 31-02<br>RPC<br>mg/kg | On-site Marsh<br>Station 2<br>Dec 13-01<br>Jan 31-02<br>RPC<br>mg/kg | Reference Marsh<br>Station 1<br>Dec 13-01<br>Jan 31-02<br>RPC<br>mg/kg | Reference Marsh<br>Station 2<br>Dec 13-01<br>Jan 31-02<br>RPC<br>mg/kg | Reference Marsh<br>Station 1<br>Dec 13-01<br>Jan 7-02<br>PAS<br>mg/kg | Reference Marsh<br>Station 2<br>Dec 13-01<br>Jan 7-02<br>PAS<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alpha-BHC | - | - | 0.006 | nd | nd | nd | nd | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.00094 | 0.00138 | 0.003 | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor | - | - | 0.0003 (no effect) | nd | nd | nd | nd | nd | nd | nd | nd |
| Aldrin | - | - | 0.002 | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor Epoxide | 0.0006 | 0.00274 | 0.005 | nd | nd | nd | nd | nd | nd | nd | nd |
| Alpha-Endosulfan | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDE | 0.00142 | 0.00675 | 0.005 | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin | 0.00267 | 0.0624 | 0.003 | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-Endosulfan | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDD | 0.00354 | 0.00851 | 0.008 | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd | nd | nd | nd | nd |
| Mirex | - | - | 0.007 | nd | nd | nd | nd | nd | nd | nd | nd |
| Chlordane | 0.0045 | 0.00887 | 0.007 | nd | nd | nd | nd | nd | nd | nd | nd |
| Dieldrin | 0.00285 | 0.00667 | 0.002 | nd | nd | nd | nd | nd | nd | nd | nd |
| Methoxychlor | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Hexachlorobenzene | - | - | 0.02 | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-BHC | - | - | 0.006 | nd | nd | nd | nd | nd | nd | nd | nd |
| Delta-BHC | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Aldehyde | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Ketone | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDD | 0.00354 | 0.00851 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDE | 0.00142 | 0.00675 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Toxaphene | 0.0001 | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Endosulfan Sulfate | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| 2-Chloronaphthalene | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Alpha-chlordane | | | | nt | nt | nt | nt | nt | nt | nt | nt |
| Gamma-chlordane | | | | nt | nt | nt | nt | nt | nt | nt | nt |
| PCBs | 0.0341 | 0.277 | 0.06 (1254) | nd | nd | nd | nd | nd | nd | nd | nd |

**Table B.6: Sediment Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Neds Pond (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Neds Pond (QA Sample)<br>Jan 15-02<br>Jan 31-02<br>RPC<br>mg/kg | Neds Pond (QA Sample)<br>Nov 20-01<br>June 10-02<br>ECB<br>mg/kg | Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 31-02<br>RPC<br>mg/kg | Pond 2 (QA Sample)<br>Nov 20-01<br>June 10-02<br>ECB<br>mg/kg | Black Duck Pond (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Black Duck Pond (QA Sample)<br>Jan 15-02<br>Jan 31-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alpha-BHC | - | - | 0.006 | nd | nd | nd | nd | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.00094 | 0.00138 | 0.003 | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor | - | - | 0.0003 (no effect) | nd | nd | nt | nd | nd | nt | nd | nd |
| Aldrin | - | - | 0.002 | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor Epoxide | 0.0006 | 0.00274 | 0.005 | nd | nd | nd | nd | nd | nd | nd | nd |
| Alpha-Endosulfan | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDE | 0.00142 | 0.00675 | 0.005 | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin | 0.00267 | 0.0624 | 0.003 | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-Endosulfan | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDD | 0.00354 | 0.00651 | 0.008 | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd | nd | nd | nd | nd |
| Mirex | - | - | 0.007 | nd | nd | nd | nd | nd | nd | nd | nd |
| Chlordane | 0.0045 | 0.00887 | 0.007 | nd | nd | nt | nd | nd | nt | nd | nd |
| Dieldrin | 0.00285 | 0.00667 | 0.002 | nd | nd | nd | nd | nd | nd | nd | nd |
| Methoxychlor | - | - | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Hexachlorobenzene | - | - | 0.02 | nd | nd | nt | nd | nd | nt | nd | nd |
| Beta-BHC | - | - | 0.006 | nd | nd | nt | nd | nd | nt | nd | nd |
| Delta-BHC | - | - | - | nd | nd | nt | nd | nd | nt | nd | nd |
| Endrin Aldehyde | - | - | - | nd | nd | nt | nd | nd | nt | nd | nd |
| Endrin Ketone | - | - | - | nd | nd | nt | nd | nd | nt | nd | nd |
| Ortho-Para DDD | 0.00354 | 0.00651 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDE | 0.00142 | 0.00675 | - | nd | nd | nd | nd | nd | nd | nd | nd |
| Toxaphene | 0.0001 | - | - | nd | nd | nt | nd | nd | nt | nd | nd |
| Endosulfan Sulfate | - | - | - | nd | nd | nt | nd | nd | nt | nd | nd |
| 2-Chloronaphthalene | - | - | - | nd | nd | nt | nd | nd | nt | nd | nd |
| Alpha-chlordane | | | | nt | nt | nd | nt | nt | nd | nt | nt |
| Gamma-chlordane | | | | nt | nt | nd | nt | nt | nd | nt | nt |
| PCBs | 0.0341 | 0.277 | 0.06 (1254) | nd | nd | nd (<10 ng/g) | nd | nd | nd (<10 ng/g) | nd | nd |

**Table B.8: Sediment Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Black Duck Pond (QA Sample)<br>Nov 20-01<br>June 10-02<br>ECB<br>mg/kg | Control Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Control Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 31-02<br>RPC<br>mg/kg | Control Pond 2 (QA Sample)<br>Nov 20-01<br>June 10-02<br>ECB<br>mg/kg |
|---|---|---|---|---|---|---|---|
| Alpha-BHC | - | - | 0.006 | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.00094 | 0.00138 | 0.003 | nd | nd | nd | nd |
| Heptachlor | - | - | 0.0003 (no effect) | nt | nd | nd | nt |
| Aldrin | - | - | 0.002 | nd | nd | nd | nd |
| Heptachlor Epoxide | 0.0006 | 0.00274 | 0.005 | nd | nd | nd | nd |
| Alpha-Endosulfan | - | - | - | nd | nd | nd | nd |
| Para-Para DDE | 0.00142 | 0.00675 | 0.005 | nd | nd | nd | nd |
| Endrin | 0.00267 | 0.0624 | 0.003 | nd | nd | nd | nd |
| Beta-Endosulfan | - | - | - | nd | nd | nd | nd |
| Para-Para DDD | 0.00354 | 0.00851 | 0.008 | nd | nd | nd | nd |
| Ortho-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd |
| Para-Para DDT | 0.00119 | 0.00477 | 0.004 | nd | nd | nd | nd |
| Mirex | - | - | 0.007 | nd | nd | nd | nd |
| Chlordane | 0.0045 | 0.00887 | 0.007 | nt | nd | nd | nt |
| Dieldrin | 0.00285 | 0.00667 | 0.002 | nd | nd | nd | nd |
| Methoxychlor | - | - | - | nd | nd | nd | nd |
| Hexachlorobenzene | - | - | 0.02 | nt | nd | nd | nt |
| Beta-BHC | - | - | 0.006 | nt | nd | nd | nt |
| Delta-BHC | - | - | - | nt | nd | nd | nt |
| Endrin Aldehyde | - | - | - | nt | nd | nd | nt |
| Endrin Ketone | - | - | - | nt | nd | nd | nt |
| Ortho-Para DDD | 0.00354 | 0.00851 | - | nd | nd | nd | nd |
| Ortho-Para DDE | 0.00142 | 0.00675 | - | nd | nd | nd | nd |
| Toxaphene | 0.0001 | - | - | nt | nd | nd | nt |
| Endosulfan Sulfate | - | - | - | nt | nd | nd | nt |
| 2-Chloronaphthalene | - | - | - | nt | nd | nd | nt |
| Alpha-chlordane | | | | nd | nt | nt | nd |
| Gamma-chlordane | | | | nd | nt | nt | nd |
| PCBs | 0.0341 | 0.277 | 0.06 (1254) | nd (<10 ng/g) | nd | nd | nd (<10 ng/g) |

Notes: CCME ISQG - CCME (2001) Interim Sediment Quality Guideline (freshwater)
PEL - Probable Effects Level
Highlighted values in red exceed CCME PEL
MOE (1993) - Ontario Ministry of the Environment. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario
nd - not detected
n/a - not applicable
PAS - Philip Analytical Services
RPC - Research and Productivity Lab
ECB - Environment Canada Lab, Moncton
QA Samples were a mixture of all of the samples collected in each of the four ponds (i.e. all of Ned's Pond samples were combined to create one mixture, etc.) which were then submitted to three different laboratories for comparison of results
The highest standard detection limits that were reported are presented for RPC and PAS

**Table B.9: Surface Water Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab | CCME (2001) | GCDWQ (2001) | Detection Limit<br>RPC | Neds Pond<br>Station 1<br>Nov 21-01<br>Dec 31-01<br>RPC | Ned's Pond<br>Station 2<br>Nov 21-01<br>Dec 31-01<br>RPC | Ned's Pond<br>Station 3<br>Nov 21-01<br>Dec 31-01<br>RPC | Ned's Pond<br>Station 4<br>Nov 21-01<br>Dec 31-01<br>RPC | Ned's Pond<br>Station 5<br>Nov 21-01<br>Dec 31-01<br>RPC | Pond 2<br>Station 1<br>Nov 21-01<br>Dec 31-01<br>RPC | Pond 2<br>Station 2<br>Nov 21-01<br>Dec 31-01<br>RPC | Pond 2<br>Station 3<br>Nov 21-01<br>Dec 31-01<br>RPC | Pond 2<br>Station 4<br>Nov 21-01<br>Dec 31-01<br>RPC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L |
| Alpha-BHC | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.01 | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Aldrin | - | 0.7 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor Epoxide | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Alpha-Endosulfan | 0.02 (endosulfan) | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDE | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-Endosulfan | 0.02 (endosulfan) | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDD | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDT | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDT | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Mirex | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Chlordane | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Dieldrin | - | 0.7 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Methoxychlor | - | 900 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Hexachlorobenzene | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-BHC | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Delta-BHC | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Aldehyde | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Ketone | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDD | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDE | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Toxaphene | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| Endosulfan Sulfate | 0.02 (endosulfan) | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| 2-Chloronaphthalene | - | - | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| PCBs | - | - | 1 | nt | nt | nt | nt | nt | nt | nt | nt | |

**Table B.9: Surface Water Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab | CCME (2001) | GCDWQ (2001) | Pond 2<br>Station 5<br>Nov 21-01<br>Dec 31-01<br>RPC | Black Duck Pond<br>Station 1<br>Nov 22-01<br>Dec 31-01<br>RPC | Black Duck Pond<br>Station 2<br>Nov 22-01<br>Dec 31-01<br>RPC | Black Duck Pond<br>Station 3<br>Nov 22-01<br>Dec 31-01<br>RPC | Black Duck Pond<br>Station 4<br>Nov 22-01<br>Dec 31-01<br>RPC | Black Duck Pond<br>Station 5<br>Nov 22-01<br>Dec 31-01<br>RPC | Control Pond 2<br>Station 1<br>Nov 21-01<br>Dec 31-01<br>RPC |
|---|---|---|---|---|---|---|---|---|---|
| | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L |
| Alpha-BHC | - | - | nd | nd | nd | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.01 | - | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor | - | - | nd | nd | nd | nd | nd | nd | nd |
| Aldrin | - | 0.7 | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor Epoxide | - | - | nd | nd | nd | nd | nd | nd | nd |
| Alpha-Endosulfan | 0.02 (endosulfan) | - | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDE | - | - | nd | nd | nd | nd | nd | nd | nd |
| Endrin | - | - | nd | nd | nd | nd | nd | nd | nd |
| Beta-Endosulfan | 0.02 (endosulfan) | - | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDD | - | - | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDT | - | - | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDT | - | - | nd | nd | nd | nd | nd | nd | nd |
| Mirex | - | - | nd | nd | nd | nd | nd | nd | nd |
| Chlordane | - | - | nd | nd | nd | nd | nd | nd | nd |
| Dieldrin | - | 0.7 | nd | nd | nd | nd | nd | nd | nd |
| Methoxychlor | - | 900 | nd | nd | nd | nd | nd | nd | nd |
| Hexachlorobenzene | - | - | nd | nd | nd | nd | nd | nd | nd |
| Beta-BHC | - | - | nd | nd | nd | nd | nd | nd | nd |
| Delta-BHC | - | - | nd | nd | nd | nd | nd | nd | nd |
| Endrin Aldehyde | - | - | nd | nd | nd | nd | nd | nd | nd |
| Endrin Ketone | - | - | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDD | - | - | nd | nd | nd | nd | nd | nd | nd |
| Ortho-Para DDE | - | - | nd | nd | nd | nd | nd | nd | nd |
| Toxaphene | - | - | nd | nd | nd | nd | nd | nd | nd |
| Endosulfan Sulfate | 0.02 (endosulfan) | - | nd | nd | nd | nd | nd | nd | nd |
| 2-Chloronaphthalene | - | - | nd | nd | nd | nd | nd | nd | nd |
| PCBs | - | - | | nt | nt | nt | nt | nt | nt |

**Table B.9: Surface Water Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab | CCME (2001) | GCDWQ (2001) | Control Pond 2<br>Station 2<br>Nov 21-01<br>Dec 31-01<br>RPC | Control Pond 2<br>Station 3<br>Nov 21-01<br>Dec 31-01<br>RPC | Control Pond 2<br>Station 4<br>Nov 21-01<br>Dec 31-01<br>RPC | Control Pond 2<br>Station 5<br>Nov 21-01<br>Dec 31-01<br>RPC |
|---|---|---|---|---|---|---|
| | ug/L | ug/L | ug/L | ug/L | ug/L | ug/L |
| Alpha-BHC | - | - | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.01 | - | nd | nd | nd | nd |
| Heptachlor | - | - | nd | nd | nd | nd |
| Aldrin | - | 0.7 | nd | nd | nd | nd |
| Heptachlor Epoxide | - | - | nd | nd | nd | nd |
| Alpha-Endosulfan | 0.02 (endosulfan) | - | nd | nd | nd | nd |
| Para-Para DDE | - | - | nd | nd | nd | nd |
| Endrin | - | - | nd | nd | nd | nd |
| Beta-Endosulfan | 0.02 (endosulfan) | - | nd | nd | nd | nd |
| Para-Para DDD | - | - | nd | nd | nd | nd |
| Ortho-Para DDT | - | - | nd | nd | nd | nd |
| Para-Para DDT | - | - | nd | nd | nd | nd |
| Mirex | - | - | nd | nd | nd | nd |
| Chlordane | - | - | nd | nd | nd | nd |
| Dieldrin | - | 0.7 | nd | nd | nd | nd |
| Methoxychlor | - | 900 | nd | nd | nd | nd |
| Hexachlorobenzene | - | - | nd | nd | nd | nd |
| Beta-BHC | - | - | nd | nd | nd | nd |
| Delta-BHC | - | - | nd | nd | nd | nd |
| Endrin Aldehyde | - | - | nd | nd | nd | nd |
| Endrin Ketone | - | - | nd | nd | nd | nd |
| Ortho-Para DDD | - | - | nd | nd | nd | nd |
| Ortho-Para DDE | - | - | nd | nd | nd | nd |
| Toxaphene | - | - | nd | nd | nd | nd |
| Endosulfan Sulfate | 0.02 (endosulfan) | - | nd | nd | nd | nd |
| 2-Chloronaphthalene | - | - | nd | nd | nd | nd |
| PCBs | - | - | nt | nt | nt | nt |

Notes:
CCME (2001) - Canadian Water Quality Guidelines for the Protection of Aquatic Life (freshwater)
GCDWQ (2001) - Guidelines for Canadian Drinking Water Quality
nd - not detected
n/a - not applicable
nt - not tested
RPC - Research and Productivity Lab

**Table B.10: Fish Pesticide Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | Detection Limit<br>RPC<br>mg/kg | Ned's Pond<br>Carcass 1<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Ned's Pond<br>Carcass 2<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Ned's Pond<br>Carcass 3<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Ned's Pond<br>Fillet 1<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Ned's Pond<br>Fillet 2<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Ned's Pond<br>Fillet 3<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Pond 2<br>Carcass 1<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Pond 2<br>Fillet 1<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|
| Aldrin | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Alpha-BHC | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Beta-BHC | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Delta-BHC | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDD | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Para-Para DDE | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Endosulfan II | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Endosulfan Sulfate | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Aldehyde | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Endrin Ketone | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Heptachlor | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Methoxychlor | 0.03 | nd | nd | nd | nd | nd | nd | nd | nd |
| Aroclor 1242 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd |
| Aroclor 1254 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd |
| Aroclor 1260 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd |

**Table B.10: Fish Pesticid**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | Black Duck Pond<br>Carcass 1<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Black Duck Pond<br>Fillet 1<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Control Pond 2<br>Carcass 1<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Control Pond 2<br>Carcass 2<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Control Pond 2<br>Fillet 1<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg | Control Pond 2<br>Fillet 2<br>Dec 13-01<br>Feb 16-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|
| Aldrin | nd | nd | nd | nd | nd | nd |
| Alpha-BHC | nd | nd | nd | nd | nd | nd |
| Beta-BHC | nd | nd | nd | nd | nd | nd |
| Gamma-BHC (Lindane) | nd | nd | nd | nd | nd | nd |
| Delta-BHC | nd | nd | nd | nd | nd | nd |
| Para-Para DDD | nd | nd | nd | nd | nd | nd |
| Para-Para DDE | nd | nd | nd | nd | nd | nd |
| Endosulfan II | nd | nd | nd | nd | nd | nd |
| Endosulfan Sulfate | nd | nd | nd | nd | nd | nd |
| Endrin | nd | nd | nd | nd | nd | nd |
| Endrin Aldehyde | nd | nd | nd | nd | nd | nd |
| Endrin Ketone | nd | nd | nd | nd | nd | nd |
| Heptachlor | nd | nd | nd | nd | nd | nd |
| Methoxychlor | nd | nd | nd | nd | nd | nd |
| Aroclor 1242 | nd | nd | nd | nd | nd | nd |
| Aroclor 1254 | nd | nd | nd | nd | nd | nd |
| Aroclor 1260 | nd | nd | nd | nd | nd | nd |

Notes:
nd - not detected
n/a - not applicable
RPC - Research and Productivity Lab

**Table B.11: Sediment Metals Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Detection Limit RPC<br><br><br><br>mg/kg | Detection Limit PAS<br><br><br><br>mg/kg | Detection Limit ECB<br><br><br><br>mg/kg | Neds Pond Station 1<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Ned's Pond Station 2<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Ned's Pond Station 3<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Ned's Pond Station 4<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Ned's Pond Station 5<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Pond 2 Station 1<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | - | - | - | 1.0 | 10 | not tested | 43500 | 18100 | 21900 | 31700 | 27500 | 42500 |
| Antimony | - | - | - | 0.1 | 2 | 1.0 | 0.8 | 0.5 | 0.3 | 0.6 | 0.6 | 0.3 |
| Arsenic | 5.9 | 17 | 6 | 1.0 | 2 | 1.0 | 5 | 2 | 3 | 4 | 4 | 3 |
| Barium | - | - | - | 1.0 | 5 | not tested | 292 | 134 | 160 | 206 | 196 | 283 |
| Beryllium | - | - | - | 0.1 | 5 | not tested | 1.1 | 0.4 | 0.5 | 0.8 | 0.7 | 1 |
| Boron | - | - | - | 1.0 | 5 | not tested | 22 | 10 | 10 | 12 | 14 | 16 |
| Cadmium | 0.6 | 3.5 | 0.6 | 0.1 | 0.3 | 1.0 | ***1.2*** | ***0.7*** | ***0.7*** | ***0.8*** | ***1.2*** | 0.6 |
| Chromium | 37.3 | 90 | 26 | 1.0 | 2 | 1.0 | ***70*** | 30 | 37 | ***45*** | ***47*** | ***52*** |
| Cobalt | - | - | - | 0.1 | 1 | 1.0 | 22.8 | 6.4 | 6.6 | 12.7 | 12.7 | 13.9 |
| Copper | 35.7 | 197 | 16 | 1.0 | 2 | 1.0 | ***44*** | 17 | 19 | 30 | 31 | 22 |
| Iron | - | - | - | 20.0 | 20 | not tested | 38300 | 16600 | 18100 | 24700 | 23000 | 34300 |
| Lead | 35 | 91.3 | 31 | 0.1 | 0.5 | 0.1 | ***59.1*** | 31.5 | 28.5 | ***37.6*** | ***53.5*** | 22.4 |
| Manganese | - | - | 460 | 1.0 | 2 | 1.0 | *627* | *618* | *533* | *602* | *904* | *523* |
| Molybdenum | - | - | - | 0.1 | 2 | 1.0 | 1.2 | 0.6 | 0.6 | 0.8 | 1.2 | 0.6 |
| Nickel | - | - | 16 | 1.0 | 2 | 1.0 | 35 | 11 | 13 | *23* | *18* | *21* |
| Selenium | - | - | - | 1.0 | 2 | not tested | 3 | 2 | 2 | 2 | 3 | 2 |
| Silver | - | - | - | 1.0 | 0.5 | 1.0 | 0.3 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 |
| Strontium | - | - | - | 0.1 | 5 | not tested | 84 | 60 | 75 | 84 | 85 | 121 |
| Thallium | - | - | - | 1.0 | 0.1 | not tested | 0.3 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 |
| Tin | - | - | - | 0.1 | 0.1 | 1.0 | nt | nt | nt | nt | nt | nt |
| Uranium | - | - | - | 0.1 | 0.1 | not tested | 2.2 | 1.8 | 1.9 | 2.4 | 3.5 | 1.4 |
| Vanadium | - | - | - | 1.0 | 2 | 1.0 | 96 | 40 | 51 | 66 | 83 | 72 |
| Zinc | 123 | 315 | 120 | 1.0 | 2 | 1.0 | ***250*** | 104 | 101 | ***128*** | ***169*** | ***134*** |
| Mercury | 0.17 | 0.486 | 0.2 | 0.01 | 0.01 | 0.01 | ***0.181706671*** | 0.150521548 | 0.160763957 | 0.160368566 | ***0.185593463*** | 0.081786782 |

**Table B.11: Sediment Metals Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Pond 2 Station 1 (Dup)<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Pond 2 Station 2<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Pond 2 Station 3<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Pond 2 Station 4<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Pond 2 Station 5<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Black Duck Pond Station 1<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Black Duck Pond Station 2<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Black Duck Pond Station 3<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | - | - | - | 43100 | 35500 | 62400 | 48500 | 25800 | 41300 | 49000 | 55000 |
| Antimony | - | - | - | 0.3 | 0.6 | 0.6 | 0.7 | 0.2 | 0.7 | 0.3 | 0.4 |
| Arsenic | 5.9 | 17 | 6 | 3 | 3 | 4 | 4 | 3 | ***8*** | 4 | 5 |
| Barium | - | - | - | 297 | 295 | 361 | 312 | 178 | 366 | 297 | 357 |
| Beryllium | - | - | - | 1.1 | 0.9 | 1.4 | 1.2 | 0.5 | 1.3 | 1.5 | 1.7 |
| Boron | - | - | - | 18 | 19 | 33 | 27 | 12 | 20 | 19 | 24 |
| Cadmium | 0.6 | 3.5 | 0.6 | ***0.7*** | ***0.9*** | 0.6 | ***0.8*** | ***0.8*** | ***1.5*** | ***0.9*** | ***1.3*** |
| Chromium | 37.3 | 90 | 26 | ***55*** | ***59*** | ***90*** | ***74*** | ***49*** | ***52*** | ***53*** | ***60*** |
| Cobalt | - | - | - | 15 | 17.8 | 22 | 19.5 | 19.9 | 23.1 | 18.3 | 20.1 |
| Copper | 35.7 | 197 | 16 | 24 | 29 | ***57*** | ***44*** | 21 | 25 | 24 | 28 |
| Iron | - | - | - | 35000 | 32900 | 45400 | 40300 | 20300 | 61300 | 42600 | 53300 |
| Lead | 35 | 91.3 | 31 | 22.5 | 29 | 30.2 | 34.4 | 12 | ***46.2*** | 20.1 | 33.6 |
| Manganese | - | - | 460 | *527* | *1380* | *704* | *729* | *552* | *4240* | *2340* | *2660* |
| Molybdenum | - | - | - | 0.8 | 0.7 | 1.1 | 1 | 1.4 | 1.9 | 1.4 | 1.5 |
| Nickel | - | - | 16 | *22* | *25* | *45* | *35* | 16 | *24* | *24* | *28* |
| Selenium | - | - | - | 3 | 3 | 2 | 3 | 3 | 4 | 4 | 3 |
| Silver | - | - | - | 0.3 | 0.2 | 0.3 | 0.2 | 0.1 | 0.2 | 0.2 | 0.3 |
| Strontium | - | - | - | 128 | 97 | 88 | 86 | 63 | 73 | 83 | 72 |
| Thallium | - | - | - | 0.2 | 0.2 | 0.3 | 0.3 | 0.1 | 0.3 | 0.3 | 0.4 |
| Tin | - | - | - | nt | nt | nt | nt | nt | nt | nt | nt |
| Uranium | - | - | - | 1.7 | 1.4 | 1.8 | 1.9 | 2 | 4.2 | 4.5 | 4.8 |
| Vanadium | - | - | - | 77 | 75 | 109 | 94 | 59 | 82 | 86 | 92 |
| Zinc | 123 | 315 | 120 | ***145*** | ***177*** | ***156*** | ***177*** | ***138*** | ***254*** | ***206*** | ***247*** |
| Mercury | 0.17 | 0.486 | 0.2 | 0.074807151 | 0.105699464 | 0.09636443 | 0.117021379 | 0.093258471 | ***0.200847458*** | 0.14311526 | ***0.194839124*** |

**Table B.11: Sediment Metals Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Black Duck Pond Station 3 (Dup)<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Black Duck Pond Station 4<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Black Duck Pond Station 5<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Control Pond 2 Station 1<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Control Pond 2 Station 1 (Dup)<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Control Pond 2 Station 2<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Control Pond 2 Station 3<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | - | - | - | 55700 | 60400 | 46800 | 42200 | 41800 | 31300 | 22500 |
| Antimony | - | - | - | 0.5 | 0.4 | 0.5 | 1.1 | 1 | 0.8 | 0.7 |
| Arsenic | 5.9 | 17 | 6 | 5 | 4 | 4 | ***6*** | ***7*** | 4 | 3 |
| Barium | - | - | - | 370 | 372 | 330 | 395 | 401 | 359 | 308 |
| Beryllium | - | - | - | 1.7 | 1.6 | 1.4 | 1.2 | 1.2 | 1 | 0.8 |
| Boron | - | - | - | 24 | 24 | 22 | 34 | 33 | 34 | 24 |
| Cadmium | 0.6 | 3.5 | 0.6 | ***1.4*** | ***0.7*** | ***1.2*** | ***1.6*** | ***1.7*** | ***2.3*** | ***2.1*** |
| Chromium | 37.3 | 90 | 26 | ***63*** | ***61*** | ***55*** | ***46*** | ***45*** | ***44*** | 27 |
| Cobalt | - | - | - | 21.2 | 17.9 | 20.8 | 19.4 | 20.2 | 15.4 | 16.1 |
| Copper | 35.7 | 197 | 16 | 29 | 26 | 23 | ***50*** | ***52*** | 32 | 23 |
| Iron | - | - | - | 53800 | 49600 | 47300 | 38800 | 39100 | 19000 | 35400 |
| Lead | 35 | 91.3 | 31 | 33.5 | 28.8 | ***38.9*** | ***58.4*** | ***58.9*** | ***38.7*** | ***35.4*** |
| Manganese | - | - | 460 | *2870* | *2030* | *2590* | *2630* | *2640* | *1320* | *9020* |
| Molybdenum | - | - | - | 1.6 | 1 | 1.4 | 2 | 2 | 1.6 | 1.5 |
| Nickel | - | - | 16 | *30* | *28* | *26* | *41* | *42* | *42* | *39* |
| Selenium | - | - | - | 4 | 3 | 3 | 3 | 4 | 5 | 4 |
| Silver | - | - | - | 0.3 | 0.3 | 0.2 | 0.5 | 0.5 | 0.4 | 0.3 |
| Strontium | - | - | - | 77 | 98 | 69 | 40 | 39 | 42 | 24 |
| Thallium | - | - | - | 0.3 | 0.3 | 0.3 | 0.5 | 0.6 | 0.4 | 0.4 |
| Tin | - | - | - | nt | nt | nt | nt | nt | nt | nt |
| Uranium | - | - | - | 4.9 | 2.9 | 3.8 | 3.3 | 3.4 | 3.3 | 2.6 |
| Vanadium | - | - | - | 101 | 80 | 81 | 76 | 74 | 60 | 38 |
| Zinc | 123 | 315 | 120 | ***261*** | ***164*** | ***226*** | ***237*** | ***245*** | ***336*** | ***298*** |
| Mercury | 0.17 | 0.486 | 0.2 | ***0.185192059*** | 0.121858959 | ***0.177189606*** | ***0.22965629*** | nt | 0.141053614 | 0.148626941 |

**Table B.11: Sediment Metals Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Control Pond 2 Station 4<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | Control Pond 2 Station 5<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | On-site Marsh Station 1<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | On-site Marsh Station 2<br>Nov 20-01<br>Dec 11-01<br>RPC<br>mg/kg | On-site Marsh Station 1<br>Dec 13-01<br>Jan 07-02<br>RPC<br>mg/kg | On-site Marsh Station 2<br>Dec 13-01<br>Jan 07-02<br>RPC<br>mg/kg | On-site Marsh Station 1 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | - | - | - | 32800 | 28300 | 42300 | 16800 | 66900 | 64300 | 15000 |
| Antimony | - | - | - | 1.2 | 1.1 | 1.2 | 1 | 0.4 | 0.4 | <2 |
| Arsenic | 5.9 | 17 | 6 | 4 | 4 | 6 | 4 | 2 | 2 | 2 |
| Barium | - | - | - | 256 | 344 | 166 | 77 | 314 | 374 | 13 |
| Beryllium | - | - | - | 1 | 1 | 0.9 | 0.3 | 1.3 | 1.3 | <5 |
| Boron | - | - | - | 30 | 30 | 16 | 8 | 11 | 12 | <5 |
| Cadmium | 0.6 | 3.5 | 0.6 | 2.1 | 3.5 | 1 | 0.9 | 0.1 | 0.2 | <0.3 |
| Chromium | 37.3 | 90 | 26 | 43 | 39 | 58 | 30 | 74 | 77 | 26 |
| Cobalt | - | - | - | 16.7 | 17.9 | 10 | 5.8 | 11.9 | 11 | 7 |
| Copper | 35.7 | 197 | 16 | 32 | 30 | 42 | 44 | 17 | 17 | 15 |
| Iron | - | - | - | 25200 | 28400 | 34900 | 16400 | 37100 | 32600 | 15000 |
| Lead | 35 | 91.3 | 31 | 42.4 | 49.8 | 43 | 26.7 | 10.8 | 11.2 | 6.3 |
| Manganese | - | - | 460 | 738 | 2820 | 234 | 129 | 576 | 508 | 170 |
| Molybdenum | - | - | - | 2.5 | 1.4 | 3.1 | 2.3 | 0.7 | 0.8 | <2 |
| Nickel | - | - | 16 | 47 | 48 | 25 | 18 | 22 | 21 | 14 |
| Selenium | - | - | - | 5 | 6 | 2 | 1 | 1 | 2 | <2 |
| Silver | - | - | - | 0.4 | 0.5 | 0.2 | 0.1 | 0.3 | 0.2 | <0.5 |
| Strontium | - | - | - | 44 | 37 | 61 | 43 | 183 | 183 | 6 |
| Thallium | - | - | - | 0.5 | 0.4 | 0.2 | 0.1 | 0.3 | 0.3 | <0.1 |
| Tin | - | - | - | nt | nt | nt | nt | nt | nt | nt |
| Uranium | - | - | - | 3.6 | 3.6 | 1.2 | 0.5 | 1 | 1 | 0.3 |
| Vanadium | - | - | - | 58 | 66 | 131 | 58 | 129 | 115 | 45 |
| Zinc | 123 | 315 | 120 | 286 | 329 | 586 | 274 | 150 | 142 | 100 |
| Mercury | 0.17 | 0.486 | 0.2 | 0.13624322 | 0.195436759 | 0.174371591 | 0.160113856 | 0.04 | 0.04 | 0.05 |

**Table B.11: Sediment Metals Chemistry**

| Sample Number | CCME (2001) ISQG | CCME (2001) PEL | MOE (1993) Lowest Effect Level | Control Pond 2 Station 4 | Control Pond 2 Station 5 | On-site Marsh Station 1 | On-site Marsh Station 2 | On-site Marsh Station 1 | On-site Marsh Station 2 | On-site Marsh Station 1 Sample 2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | Nov 20-01 | Nov 20-01 | Nov 20-01 | Nov 20-01 | Dec 13-01 | Dec 13-01 | Dec 13-01 |
| Date Reported | | | | Dec 11-01 | Dec 11-01 | Dec 11-01 | Dec 11-01 | Jan 07-02 | Jan 07-02 | Dec 27-01 |
| Lab | | | | RPC | RPC | RPC | RPC | RPC | RPC | PAS |
| Units | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| Aluminum | - | - | - | 32800 | 28300 | 42300 | 16800 | 66900 | 64300 | 15000 |
| Antimony | - | - | - | 1.2 | 1.1 | 1.2 | 1 | 0.4 | 0.4 | <2 |
| Arsenic | 5.9 | 17 | 6 | *4* | *4* | ***6*** | 4 | 2 | *2* | *2* |
| Barium | - | - | - | 256 | 344 | 166 | 77 | 314 | 374 | 13 |
| Beryllium | - | - | - | 1 | 1 | 0.9 | 0.3 | 1.3 | 1.3 | <5 |
| Boron | - | - | - | 30 | 30 | 16 | 8 | 11 | 12 | <5 |
| Cadmium | 0.6 | 3.5 | 0.6 | ***2.1*** | ***3.5*** | ***1*** | ***0.9*** | 0.1 | 0.2 | <0.3 |
| Chromium | 37.3 | 90 | 26 | *43* | ***39*** | ***58*** | 30 | ***74*** | ***77*** | 26 |
| Cobalt | - | - | - | 16.7 | 17.9 | 10 | 5.8 | 11.9 | 11 | 7 |
| Copper | 35.7 | 197 | 16 | 32 | 30 | ***42*** | ***44*** | 17 | 17 | 15 |
| Iron | - | - | - | 25200 | 28400 | 34900 | 16400 | 37100 | 32600 | 15000 |
| Lead | 35 | 91.3 | 31 | ***42.4*** | ***49.8*** | ***43*** | 28.7 | 10.8 | 11.2 | 6.3 |
| Manganese | - | - | 460 | *738* | *2820* | 234 | 129 | *576* | *508* | 170 |
| Molybdenum | - | - | - | 2.5 | 1.4 | 3.1 | 2.3 | 0.7 | 0.8 | <2 |
| Nickel | - | - | 16 | *47* | *48* | *25* | *18* | *22* | *21* | 14 |
| Selenium | - | - | - | 5 | 6 | 2 | 1 | 1 | 2 | <2 |
| Silver | - | - | - | 0.4 | 0.5 | 0.2 | 0.1 | 0.3 | 0.2 | <0.5 |
| Strontium | - | - | - | 44 | 37 | 61 | 43 | 183 | 183 | 6 |
| Thallium | - | - | - | 0.5 | 0.4 | 0.2 | 0.1 | 0.3 | 0.3 | <0.1 |
| Tin | - | - | - | nt | nt | nt | nt | nt | nt | nt |
| Uranium | - | - | - | 3.6 | 3.6 | 1.2 | 0.5 | 1 | 1 | 0.3 |
| Vanadium | - | - | - | 58 | 66 | 131 | 58 | 129 | 115 | 45 |
| Zinc | 123 | 315 | 120 | ***286*** | ***329*** | ***586*** | ***274*** | ***150*** | ***142*** | 100 |
| Mercury | 0.17 | 0.486 | 0.2 | 0.13624322 | ***0.195436759*** | ***0.174371591*** | 0.160113856 | 0.04 | 0.04 | 0.05 |

**Table B.11: Sediment Metals Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | On-site Marsh Station 2 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg | Reference Marsh Station 1<br>Dec 13-01<br>Jan 07-02<br>RPC<br>mg/kg | Reference Marsh Station 1 (Dup)<br>Dec 13-01<br>Jan 07-02<br>RPC<br>mg/kg | Reference Marsh Station 2<br>Dec 13-01<br>Jan 07-02<br>RPC<br>mg/kg | Reference Marsh Station 1 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg | Reference Marsh Station 1 Sample 2 (dup)<br>Dec 13-01<br>Jan 03-02<br>PAS<br>mg/kg | Reference Marsh Station 2 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | - | - | - | 13000 | 69500 | 70000 | 68900 | 14000 | 15000 | 14000 |
| Antimony | - | - | - | <2 | 0.5 | 0.3 | 0.4 | <2 | <2 | <2 |
| Arsenic | 5.9 | 17 | 6 | 2 | 4 | 3 | 4 | 2 | 2 | 2 |
| Barium | - | - | - | 14 | 355 | 330 | 327 | 15 | 18 | 14 |
| Beryllium | - | - | - | <5 | 1.4 | 1.2 | 1.4 | <5 | <5 | <5 |
| Boron | - | - | - | <5 | 19 | 11 | 10 | <5 | <5 | <5 |
| Cadmium | 0.6 | 3.5 | 0.6 | <0.3 | 0.2 | 0.1 | 0.1 | <0.3 | 0.3 | <0.3 |
| Chromium | 37.3 | 90 | 26 | 25 | **94** | *77* | **92** | 25 | 29 | 27 |
| Cobalt | - | - | - | 6 | 17.7 | 14.8 | 17.2 | 8 | 9 | 8 |
| Copper | 35.7 | 197 | 16 | 12 | 29 | 24 | 26 | 19 | 22 | 20 |
| Iron | - | - | - | 15000 | 42700 | 41600 | 42500 | 15000 | 17000 | 16000 |
| Lead | 35 | 91.3 | 31 | 6.1 | 13.7 | 12.6 | 12.2 | 7.9 | 8.4 | 7 |
| Manganese | - | - | 460 | 170 | *697* | *609* | *711* | 160 | 190 | 180 |
| Molybdenum | - | - | - | <2 | 0.7 | 0.5 | 0.6 | <2 | <2 | <2 |
| Nickel | - | - | 16 | 13 | *34* | *27* | *32* | 15 | *18* | *17* |
| Selenium | - | - | - | <2 | 2 | 2 | 2 | <2 | <2 | <2 |
| Silver | - | - | - | <0.5 | 0.2 | 0.2 | 0.2 | <0.5 | <0.5 | <0.5 |
| Strontium | - | - | - | 6 | 239 | 213 | 237 | 6 | 7 | 6 |
| Thallium | - | - | - | <0.1 | 0.3 | 0.3 | 0.3 | <0.1 | <0.1 | <0.1 |
| Tin | - | - | - | nt | nt | nt | nt | nt | nt | nt |
| Uranium | - | - | - | 0.3 | 1 | 0.9 | 1 | 0.4 | 0.4 | 0.4 |
| Vanadium | - | - | - | 41 | 159 | 134 | 159 | 43 | 47 | 41 |
| Zinc | 123 | 315 | 120 | 120 | 65 | 57 | 64 | 30 | 37 | 32 |
| Mercury | 0.17 | 0.486 | 0.2 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 |

**Table B.11: Sediment Metals Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | On-site Marsh Station 2 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg | Reference Marsh Station 1<br>Dec 13-01<br>Jan 07-02<br>RPC<br>mg/kg | Reference Marsh Station 1 (Dup)<br>Dec 13-01<br>Jan 07-02<br>RPC<br>mg/kg | Reference Marsh Station 2<br>Dec 13-01<br>Jan 07-02<br>RPC<br>mg/kg | Reference Marsh Station 1 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg | Reference Marsh Station 1 Sample 2 (dup)<br>Dec 13-01<br>Jan 03-02<br>PAS<br>mg/kg | Reference Marsh Station 2 Sample 2<br>Dec 13-01<br>Dec 27-01<br>PAS<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | - | - | - | 13000 | 69500 | 70000 | 68900 | 14000 | 15000 | 14000 |
| Antimony | - | - | - | <2 | 0.5 | 0.3 | 0.4 | <2 | <2 | <2 |
| Arsenic | 5.9 | 17 | 6 | 2 | 4 | 3 | 4 | 2 | 2 | 2 |
| Barium | - | - | - | 14 | 355 | 330 | 327 | 15 | 18 | 14 |
| Beryllium | - | - | - | <5 | 1.4 | 1.2 | 1.4 | <5 | <5 | <5 |
| Boron | - | - | - | <5 | 19 | 11 | 10 | <5 | <5 | <5 |
| Cadmium | 0.6 | 3.5 | 0.6 | <0.3 | 0.2 | 0.1 | 0.1 | <0.3 | 0.3 | <0.3 |
| Chromium | 37.3 | 90 | 26 | 25 | 94 | 77 | 92 | 25 | 29 | 27 |
| Cobalt | - | - | - | 6 | 17.7 | 14.8 | 17.2 | 8 | 9 | 8 |
| Copper | 35.7 | 197 | 16 | 12 | 29 | 24 | 26 | 19 | 22 | 20 |
| Iron | - | - | - | 15000 | 42700 | 41600 | 42500 | 15000 | 17000 | 16000 |
| Lead | 35 | 91.3 | 31 | 6.1 | 13.7 | 12.6 | 12.2 | 7.9 | 8.4 | 7 |
| Manganese | - | - | 460 | 170 | 697 | 609 | 711 | 160 | 190 | 180 |
| Molybdenum | - | - | - | <2 | 0.7 | 0.5 | 0.6 | <2 | <2 | <2 |
| Nickel | - | - | 16 | 13 | 34 | 27 | 32 | 15 | 18 | 17 |
| Selenium | - | - | - | <2 | 2 | 2 | 2 | <2 | <2 | <2 |
| Silver | - | - | - | <0.5 | 0.2 | 0.2 | 0.2 | <0.5 | <0.5 | <0.5 |
| Strontium | - | - | - | 6 | 239 | 213 | 237 | 6 | 7 | 6 |
| Thallium | - | - | - | <0.1 | 0.3 | 0.3 | 0.3 | <0.1 | <0.1 | <0.1 |
| Tin | - | - | - | nt | nt | nt | nt | nt | nt | nt |
| Uranium | - | - | - | 0.3 | 1 | 0.9 | 1 | 0.4 | 0.4 | 0.4 |
| Vanadium | - | - | - | 41 | 159 | 134 | 159 | 43 | 47 | 41 |
| Zinc | 123 | 315 | 120 | 120 | 65 | 57 | 64 | 30 | 37 | 32 |
| Mercury | 0.17 | 0.486 | 0.2 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.03 |

**Table B.11: Sediment Metals Chemistry**

| Sample Number<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001) ISQG<br><br><br><br>mg/kg | CCME (2001) PEL<br><br><br><br>mg/kg | MOE (1993) Lowest Effect Level<br><br><br><br>mg/kg | Ned's Pond (QA Sample)<br>Jan 11-02<br>Jan 29-02<br>RPC<br>mg/kg | Ned's Pond (Dup) (QA Sample)<br>Jan 11-02<br>Jan 29-02<br>RPC<br>mg/kg | Ned's Pond (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Ned's Pond (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>ECB<br>mg/kg | Pond 2 (QA Sample)<br>Jan 11-02<br>Jan 29-02<br>RPC<br>mg/kg | Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>PAS<br>mg/kg | Pond 2 (QA Sample)<br>Jan 15-02<br>Jan 22-02<br>ECB<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | - | - | - | 35800 | 37300 | 13000 | nt | 43500 | 14000 | nt |
| Antimony | - | - | - | 0.5 | 0.6 | <2 | <1.0 | 0.4 | <2 | <1.0 |
| Arsenic | 5.9 | 17 | 6 | 4 | 4 | 4 | 6.3 | 3 | 4 | 5.8 |
| Barium | - | - | - | 208 | 222 | 92 | nt | 259 | 100 | nt |
| Beryllium | - | - | - | 0.7 | 0.8 | <5 | nt | 0.9 | <5 | nt |
| Boron | - | - | - | nt | nt | 5 | nt | nt | 5 | nt |
| Cadmium | 0.6 | 3.5 | 0.6 | ***1.2*** | ***1.2*** | ***1.1*** | <1.0 | ***0.8*** | ***0.8*** | <1.0 |
| Chromium | 37.3 | 90 | 26 | ***54*** | ***57*** | **33** | **64** | ***65*** | ***38*** | ***57.2*** |
| Cobalt | - | - | - | 14 | 15.7 | 12 | 17.9 | 17.2 | 14 | 16.1 |
| Copper | 35.7 | 197 | 16 | 31 | 34 | 28 | ***46.5*** | 32 | 27 | 33.1 |
| Iron | - | - | - | 30000 | 31100 | 18000 | nt | 35500 | 21000 | nt |
| Lead | 35 | 91.3 | 31 | ***53.3*** | ***53.7*** | ***54*** | ***69.9*** | 27.4 | 27 | 24 |
| Manganese | - | - | 460 | *823* | *839* | *600* | *926.1* | *669* | 450 | *508.3* |
| Molybdenum | - | - | - | 1 | 1 | <2 | 2.6 | 1.1 | <2 | <1.0 |
| Nickel | - | - | 16 | *22* | *25* | *18* | *28.3* | *27* | *20* | *26* |
| Selenium | - | - | - | 4 | 4 | 2 | nt | 4 | 2 | nt |
| Silver | - | - | - | 0.2 | 0.2 | <0.5 | <1.0 | 0.2 | <0.5 | <1.0 |
| Strontium | - | - | - | 76 | 79 | 27 | nt | 80 | 27 | nt |
| Thallium | - | - | - | 0.2 | 0.2 | 0.1 | nt | 0.2 | 0.1 | nt |
| Tin | - | - | - | nt | nt | nt | <0.1 | nt | nt | 5 |
| Uranium | - | - | - | 2.5 | 2.5 | 2.1 | nt | 1.8 | 1.5 | nt |
| Vanadium | - | - | - | 67 | 73 | 41 | 109.5 | 77 | 44 | 83.6 |
| Zinc | 123 | 315 | 120 | ***182*** | ***194*** | ***160*** | ***209.2*** | ***164*** | ***140*** | 122.1 |
| Mercury | 0.17 | 0.486 | 0.2 | ***0.188460656*** | ***0.195624657*** | 0.16 | ***0.19*** | 0.125441591 | 0.1 | 0.1 |

**Table B.11: Sediment Metals Chemistry**

| Sample Number | CCME (2001) ISQG | CCME (2001) PEL | MOE (1993) Lowest Effect Level | Black Duck Pond (QA Sample) | Black Duck Pond (QA Sample) | Black Duck Pond (QA Sample) | Control Pond 2 (QA Sample) | Control Pond 2 (QA Sample) | Control Pond 2 (QA Sample) |
|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | | Jan 11-02 | Jan 15-02 | Jan 15-02 | Jan 11-02 | Jan 15-02 | Jan 15-02 |
| Date Reported | | | | Jan 29-02 | Jan 22-02 | Jan 22-02 | Jan 29-02 | Jan 22-02 | Jan 22-02 |
| Lab | | | | RPC | PAS | ECB | RPC | PAS | ECB |
| Units | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| Aluminum | - | - | - | 53900 | 20000 | nt | 36300 | 10000 | nt |
| Antimony | - | - | - | 0.5 | <2 | <1.0 | 1 | <2 | <1.0 |
| Arsenic | 5.9 | 17 | 6 | ***6*** | ***7*** | ***9.3*** | ***6*** | ***6*** | ***8.5*** |
| Barium | - | - | - | 363 | 170 | nt | 354 | 140 | nt |
| Beryllium | - | - | - | 1.5 | <5 | nt | 1 | <5 | nt |
| Boron | - | - | - | nt | <5 | nt | nt | 6 | nt |
| Cadmium | 0.6 | 3.5 | 0.6 | ***1.4*** | ***1.3*** | <1.0 | ***2.4*** | ***2.1*** | <1.0 |
| Chromium | 37.3 | 90 | 26 | ***62*** | 27 | ***44.2*** | ***42*** | 16 | 28.5 |
| Cobalt | - | - | - | 23.3 | 16 | 20.1 | 20.5 | 16 | 16.2 |
| Copper | 35.7 | 197 | 16 | 28 | 21 | 26.3 | 41 | 34 | ***39.6*** |
| Iron | - | - | - | 58200 | 34000 | nt | 37300 | 25000 | nt |
| Lead | 35 | 91.3 | 31 | ***44.2*** | ***47*** | ***43.5*** | ***58.6*** | ***57*** | ***48.3*** |
| Manganese | - | - | 460 | ***3690*** | ***2800*** | 2933 | ***4870*** | ***3800*** | ***3674*** |
| Molybdenum | - | - | - | 1.6 | <2 | <1.0 | 1.6 | <2 | <1.0 |
| Nickel | - | - | 16 | ***29*** | ***19*** | ***24.9*** | 49 | 37 | ***38.4*** |
| Selenium | - | - | - | 4 | 2 | nt | 5 | 4 | nt |
| Silver | - | - | - | 0.2 | <0.5 | <1.0 | 0.4 | <0.5 | <1.0 |
| Strontium | - | - | - | 72 | 18 | nt | 34 | 15 | nt |
| Thallium | - | - | - | 0.4 | 0.2 | nt | 0.5 | 0.2 | nt |
| Tin | - | - | - | nt | nt | 53.6 | nt | nt | <1.0 |
| Uranium | - | - | - | 4.4 | 4.6 | nt | 3.5 | 2.4 | nt |
| Vanadium | - | - | - | 89 | 45 | 89.7 | 63 | 15 | 59.1 |
| Zinc | 123 | 315 | 120 | ***270*** | ***200*** | ***194.9*** | ***299*** | ***230*** | ***200.6*** |
| Mercury | 0.17 | 0.486 | 0.2 | ***0.200549968*** | ***0.2*** | ***0.19*** | ***0.197439604*** | ***0.18*** | ***0.2*** |

Notes: CCME ISQG - CCME (2001) Interim Sediment Quality Guideline (freshwater)
PEL - Probable Effects Level
Highlighted and italicized values exceed CCME ISQG
Highlighted and shaded values exceed CCME PEL
Italicized values exceed MOE (1993)
MOE (1993) - Ontario Ministry of the Environment. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario
nd - not detected
n/a - not applicable
PAS - Philip Analytical Services
RPC - Research and Productivity Lab
ECB - Environment Canada Lab, Moncton
QA Samples were a mixture of all of the samples collected in each of the four ponds (i.e. all of Ned's Pond samples were combined to create one mixture, etc.) which were then submitted to three different laboratories for comparison of results
The highest standard detection limits that were reported are presented for RPC and PAS

**Table B.12: General Water Chemistry**

| Client ID<br>Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001)<br><br><br><br>mg/L | GCDWQ (2001)<br><br><br><br>mg/L | Detection Limit<br>RPC<br><br><br>mg/L | Neds Pond Station 1<br>Nov 21-01<br>Dec 11-01<br>RPC<br>mg/L | Ned's Pond Station 2<br>Nov 21-01<br>Dec 11-01<br>RPC<br>mg/L | Ned's Pond Station 3<br>Nov 21-01<br>Dec 11-01<br>RPC<br>mg/L | Ned's Pond Station 4<br>Nov 21-01<br>Dec 11-01<br>RPC<br>mg/L | Ned's Pond Station 5<br>Nov 21-01<br>Dec 11-01<br>RPC<br>mg/L | Pond 2 Station 1 (50 ml bottle)<br>Nov 21-01<br>Dec 11-01<br>RPC<br>mg/L | Pond 2 Station 1 (250 ml bottle)<br>Nov 21-01<br>Dec 11-01<br>RPC<br>mg/L | Pond 2 Station 2<br>Nov 21-01<br>Dec 11-01<br>RPC<br>mg/L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sodium | - | 200 (AO) | 1 | 26.4 | 28.8 | 28.5 | 29 | 28.8 | 69.8 | 31.9 | 29.8 |
| Potassium | - | - | 0.1 | 0.66 | 0.72 | 0.74 | 0.73 | 0.73 | 1.2 | 0.66 | 0.73 |
| Calcium | - | - | 1 | 24.1 | 25.7 | 25.5 | 25.9 | 25.8 | 49.6 | 27.3 | 28.2 |
| Magnesium | - | - | 1 | 5.56 | 5.88 | 6.06 | 6.42 | 5.97 | 10.6 | 6 | 6.16 |
| Iron | 0.3 | 0.3 (AO) | 0.1 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.11 | 0.49 | 0.17 |
| Manganese | - | 0.05 (AO) | 0.001 | 0.008 | 0.009 | 0.009 | 0.009 | 0.01 | 0.013 | 0.007 | 0.011 |
| Copper | 0.002-0.004 | 1 (AO) | 0.001 | < 0.001 | < 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 |
| Zinc | 0.03 | 5 (AO) | 0.001 | 0.003 | 0.002 | 0.004 | 0.003 | 0.005 | 0.003 | 0.003 | 0.006 |
| Ammonia (as N) | 0.019 | - | 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 0.05 | 0.05 | < 0.05 |
| pH (units) | 6.5-9 | 6.5-8.5 (AO) | n/a | 7.67 | 7.76 | 7.76 | 7.76 | 7.77 | 7.7 | 7.7 | 7.76 |
| Alkalinity (as CaCO3) | - | - | 1 | 75.7 | 81.3 | 81.3 | 83.2 | 80.1 | 85.2 | 85.2 | 84 |
| Chloride | - | 250 (AO) | 1 | 45.8 | 48.5 | 48.7 | 49.7 | 49.4 | 51.7 | 51.7 | 49.8 |
| Sulfate | - | 500 (AO) | 1 | 3.8 | 4.4 | 3.8 | 3.7 | 3.8 | 4.5 | 4.5 | 4.3 |
| Nitrate + Nitrite (as N) | 0.06 | 45 | 0.05 | *0.09* | < 0.05 | < 0.05 | < 0.05 | 0.06 | *0.13* | *0.13* | *0.13* |
| o-Phosphate (as P) | - | - | 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | 0.01 | 0.01 | < 0.01 |
| r-Silica (as SiO2) | - | - | 1 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.7 | 4.7 | 4.6 |
| Total Organic Carbon | - | - | 1 | 11.6 | 12.2 | 12.1 | 12.1 | 12.2 | 9.1 | 9.1 | 9.3 |
| Turbidity (NTU) | - | 5 (AO) | 0.1 | 1.34 | 1.21 | 1.47 | 1.62 | 1.13 | 0.9 | 0.9 | 1.25 |
| Total Suspended Solids | - | - | 2 | 5 | 3 | 5 | 3 | 2 | <2 | <2 | < 2 |
| Conductivity (uS/cm) | - | - | 1 | 291 | 309 | 310 | 308 | 303 | 327 | 327 | 314 |
| Calculated Parameters | | | | | | | | | | | |
| Bicarbonate as CaCO3 | - | - | n/a | 75.3453416 | 80.83398603 | 80.83398603 | 82.72376396 | 79.62979651 | 84.8 | 84.8 | 83.51945993 |
| Carbonate as CaCO3 | - | - | n/a | 0.331271642 | 0.437241976 | 0.437241976 | 0.447464041 | 0.440761304 | 0.409 | 0.409 | 0.451768068 |
| Hydroxide as CaCO3 | - | - | n/a | 0.023386757 | 0.028771997 | 0.028771997 | 0.028771997 | 0.029442183 | 0.026 | 0.026 | 0.028771997 |
| Cation sum (meq/L) | - | - | n/a | 2.83550597 | 3.04762258 | 3.04000863 | 3.11105744 | 3.06043432 | 6.42 | 3.29 | 3.23889548 |
| Anion sum (meq/L) | - | - | n/a | 2.8902001 | 3.0843296 | 3.0774796 | 3.1415734 | 3.077534 | 3.26 | 3.26 | 3.1821579 |
| % difference | - | - | n/a | -0.955238172 | -0.598616824 | -0.612522143 | -0.488049923 | -0.2785886 | 32.6 | 0.36 | 0.883617946 |
| Theoretical Conductivity | - | - | n/a | 287.6738061 | 306.4963731 | 305.6814492 | 311.8168135 | 307.2605798 | 459 | 325 | 319.9113581 |
| Hardness (mg/L as CaCO3) | - | - | n/a | 83.07378 | 88.38674 | 88.62658 | 91.10986 | 89.00706 | 168 | 92.9 | 95.78228 |
| Ion Sum (mg/L) | - | - | n/a | 157.4858 | 168.184 | 167.487 | 170.795 | 168.2222 | 245 | 180 | 175.5936 |
| Saturation pH (5°C) | - | - | n/a | 8.339074778 | 8.284872136 | 8.28808936 | 8.272731113 | 8.289749907 | 8.01 | 8.24 | 8.233747202 |
| Langelier Index (5°C) | - | - | n/a | -0.669074778 | -0.524872136 | -0.52808936 | -0.512731113 | -0.519749907 | -0.3 | -0.53 | -0.473747202 |

**Table B.12: General Water Chemistry**

| Client ID | CCME (2001) | GCDWQ (2001) | Pond 2 Station 3 | Pond 2 Station 4 | Pond 2 Station 5 | Black Duck Pond Station 1 | Black Duck Pond Station 2 | Black Duck Pond Station 3 | Black Duck Pond Station 4 | Black Duck Pond Station 5 | Control Pond 2 Station 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | | | Nov 21-01 | Nov 21-01 | Nov 21-01 | Nov 22-01 | Nov 22-01 | Nov 22-01 | Nov 22-01 | Nov 22-01 | Nov 21-01 |
| Date Reported | | | Dec 11-01 | Dec 11-01 | Dec 11-01 | Dec 11-01 | Dec 11-01 | Dec 11-01 | Dec 11-01 | Dec 11-01 | Dec 11-01 |
| Lab | | | RPC | RPC | RPC | RPC | RPC | RPC | RPC | RPC | RPC |
| Units | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| Sodium | - | 200 (AO) | 29.3 | 29.3 | 29.1 | 4.47 | 4.6 | 4.59 | 4.46 | 4.69 | 3.29 |
| Potassium | - | - | 0.67 | 0.69 | 0.68 | 0.4 | 0.41 | 0.4 | 0.39 | 0.4 | 0.34 |
| Calcium | - | - | 26.9 | 26.8 | 26.8 | 15.7 | 15.9 | 15.8 | 16.2 | 16 | 25.6 |
| Magnesium | - | - | 6.4 | 6.46 | 6.34 | 2.06 | 2.12 | 2.03 | 2.22 | 2.14 | 6.13 |
| Iron | 0.3 | 0.3 (AO) | 0.16 | 0.15 | 0.16 | 0.16 | 0.16 | 0.17 | 0.14 | 0.16 | 0.05 |
| Manganese | - | 0.05 (AO) | 0.008 | 0.007 | 0.008 | 0.013 | 0.014 | 0.014 | 0.013 | 0.02 | 0.085 |
| Copper | 0.002-0.004 | 1 (AO) | 0.001 | 0.001 | *0.012* | < 0.001 | < 0.001 | 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Zinc | 0.03 | 5 (AO) | 0.005 | 0.004 | 0.029 | 0.005 | 0.003 | 0.007 | 0.003 | 0.004 | 0.003 |
| Ammonia (as N) | 0.019 | - | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| pH (units) | 6.5-9 | 6.5-8.5 (AO) | 7.77 | 7.77 | 7.75 | 7.6 | 7.49 | 7.49 | 7.5 | 7.48 | 7.65 |
| Alkalinity (as CaCO3) | - | - | 85.7 | 86.7 | 87 | 47.2 | 45.2 | 44.6 | 45.6 | 45.4 | 93.1 |
| Chloride | - | 250 (AO) | 50.1 | 49.1 | 49.6 | 7.4 | 7.7 | 7.8 | 7.5 | 8 | 5.9 |
| Sulfate | - | 500 (AO) | 4.9 | 4.1 | 4.2 | 3.1 | 3.3 | 2.8 | 3 | 3.4 | 3.2 |
| Nitrate + Nitrite (as N) | 0.06 | 45 | *0.13* | *0.17* | *0.16* | 0.05 | 0.05 | < 0.05 | 0.05 | < 0.05 | 0.1 |
| o-Phosphate (as P) | - | - | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| r-Silica (as SiO2) | - | - | 4.6 | 4.6 | 4.6 | 3.9 | 3.8 | 3.8 | 3.8 | 3.8 | 2.4 |
| Total Organic Carbon | - | - | 9 | 9 | 8.9 | 9.1 | 9.1 | 9.2 | 8.8 | 9.3 | 3 |
| Turbidity (NTU) | - | 5 (AO) | 0.89 | 1.3 | 1.49 | 1.12 | 1.3 | 1.11 | 1.55 | 1.29 | 1.26 |
| Total Suspended Solids | - | - | 3 | 2 | 4 | 5 | 4 | 3 | 3 | 6 | 5 |
| Conductivity (uS/cm) | - | - | 318 | 324 | 324 | 115 | 113 | 114 | 117 | 119 | 192 |
| | | | | | | | | | | | |
| Calculated Parameters | | | | | | | | | | | |
| Bicarbonate as CaCO3 | - | - | 85.19697041 | 86.19346575 | 86.51456621 | 47.00419519 | 45.05367311 | 44.45541099 | 45.44908933 | 45.25642835 | 92.68848303 |
| Carbonate as CaCO3 | - | - | 0.471587408 | 0.477092069 | 0.457316729 | 0.175899447 | 0.130875411 | 0.129137532 | 0.135099281 | 0.128471895 | 0.389182791 |
| Hydroxide as CaCO3 | - | - | 0.029442183 | 0.029442183 | 0.028117066 | 0.019905359 | 0.015451477 | 0.015451477 | 0.015811388 | 0.015099759 | 0.02233418 |
| Cation sum (meq/L) | - | - | 3.16977922 | 3.18963383 | 3.15248775 | 1.16687715 | 1.18768097 | 1.1752849 | 1.20316817 | 1.19822516 | 1.93961287 |
| Anion sum (meq/L) | - | - | 3.2370823 | 3.2150555 | 3.2365228 | 1.2200179 | 1.1926809 | 1.1695312 | 1.1887857 | 1.2036508 | 2.1005302 |
| % difference | - | - | -1.050484388 | -0.711415508 | -1.315306171 | -2.226354695 | -0.210049155 | 0.245379584 | 0.601285425 | -0.225891765 | -3.982961178 |
| Theoretical Conductivity | - | - | 319.2834472 | 317.2917212 | 317.7159097 | 118.3811212 | 118.6731377 | 116.8065622 | 119.0054094 | 119.8132096 | 188.8125846 |
| Hardness (mg/L as CaCO3) | - | - | 93.5245 | 93.52188 | 93.02772 | 47.68508 | 48.43246 | 47.81214 | 49.59336 | 48.76452 | 89.18654 |
| Ion Sum (mg/L) | - | - | 175.8956 | 174.8504 | 175.3062 | 66.221 | 65.8 | 64.618 | 65.763 | 66.308 | 104.231 |
| Saturation pH (5°C) | - | - | 8.245246969 | 8.241531124 | 8.239873704 | 8.688719657 | 8.701782327 | 8.709552779 | 8.690256692 | 8.697499342 | 8.209009834 |
| Langelier Index (5°C) | - | - | -0.475246969 | -0.471531124 | -0.489873704 | -1.088719657 | -1.211782327 | -1.219552779 | -1.190256692 | -1.217499342 | -0.559009834 |

**Table B.12: General Water Chemistry**

| Client ID | CCME (2001) | GCDWQ (2001) | Control Pond 2 | Control Pond 2 | Control Pond 2 | Control Pond 2 |
|---|---|---|---|---|---|---|
| Date Sampled | | | Station 2 | Station 3 | Station 4 | Station 5 |
| Date Reported | | | Nov 21-01 | Nov 21-01 | Nov 21-01 | Nov 21-01 |
| Lab | | | Dec 11-01 | Dec 11-01 | Dec 11-01 | Dec 11-01 |
| Units | mg/L | mg/L | RPC | RPC | RPC | RPC |
| | | | mg/L | mg/L | mg/L | mg/L |
| Sodium | - | 200 (AO) | 3.49 | 3.25 | 3.33 | 3.43 |
| Potassium | - | - | 0.35 | 0.33 | 0.35 | 0.34 |
| Calcium | - | - | 24.7 | 24.5 | 27.3 | 25 |
| Magnesium | - | - | 6.61 | 6.7 | 5.42 | 6.99 |
| Iron | 0.3 | 0.3 (AO) | 0.06 | 0.05 | 0.02 | 0.05 |
| Manganese | - | 0.05 (AO) | **0.09** | **0.088** | 0.008 | **0.099** |
| Copper | 0.002-0.004 | 1 (AO) | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Zinc | 0.03 | 5 (AO) | 0.005 | 0.002 | 0.004 | 0.003 |
| Ammonia (as N) | 0.019 | - | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| pH (units) | 6.5-9 | 6.5-8.5 (AO) | 7.74 | 7.71 | 7.86 | 7.77 |
| Alkalinity (as CaCO3) | - | - | 92.2 | 90.1 | 87.4 | 95.9 |
| Chloride | - | 250 (AO) | 5.7 | 5.7 | 5.5 | 5.7 |
| Sulfate | - | 500 (AO) | 3.2 | 3.6 | 3.9 | 3.7 |
| Nitrate + Nitrite (as N) | 0.06 | 45 | ***0.09*** | ***0.09*** | ***0.07*** | 0.06 |
| o-Phosphate (as P) | - | - | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| r-Silica (as SiO2) | - | - | 2.5 | 2.5 | 2.4 | 2.4 |
| Total Organic Carbon | - | - | 2.6 | 2.7 | 2.2 | 2.6 |
| Turbidity (NTU) | - | 5 (AO) | 0.93 | 1.3 | 0.59 | 1.16 |
| Total Suspended Solids | - | - | 4 | < 2 | < 2 | 4 |
| Conductivity (uS/cm) | - | - | 189 | 191 | 186 | 191 |
| **Calculated Parameters** | | | | | | |
| Bicarbonate as CaCO3 | - | - | 91.69883573 | 89.64220111 | 86.77288109 | 95.34282286 |
| Carbonate as CaCO3 | - | - | 0.473687228 | 0.432155819 | 0.590897117 | 0.527734953 |
| Hydroxide as CaCO3 | - | - | 0.027477044 | 0.025643069 | 0.036221798 | 0.029442183 |
| Cation sum (meq/L) | - | - | 1.94393645 | 1.92970878 | 1.96363238 | 1.98704067 |
| Anion sum (meq/L) | - | - | 2.0761901 | 2.0425559 | 1.9877799 | 2.1583906 |
| % difference | - | - | -3.289788228 | -2.840876152 | -0.611111633 | -4.133464502 |
| Theoretical Conductivity | - | - | 187.6441096 | 185.9508184 | 186.4170246 | 193.0175768 |
| Hardness (mg/L as CaCO3) | - | - | 88.89588 | 88.7671 | 90.48768 | 91.20982 |
| Ion Sum (mg/L) | - | - | 103.3448 | 102.0788 | 101.8554 | 106.4762 |
| Saturation pH (5°C) | - | - | 8.228980639 | 8.241960156 | 8.209351929 | 8.208542389 |
| Langelier Index (5°C) | - | - | -0.488980639 | -0.531960156 | -0.349351929 | -0.438542389 |

CCME (2001) - Canadian Water Quality Guidelines for the Protection of Aquatic Life (freshwater)
GCDWQ (2001) - Guidelines for Canadian Drinking Water Quality
AO - Drinking water quality Aesthetic Objective guideline
Highlighted and Italicized values exceed CCME (2001)
Highlighted values exceed GCDWQ (2001)
PAS - Philip Analytical Services
RPC - Research and Productivity Lab
n/a - not applicable

**Table B.13: Surface Water Metals Chemistry**

| Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001)<br><br><br>ug/L | GCDWQ (2001)<br><br><br>ug/L | Detection Limit<br>RPC<br><br>ug/L | Ned's Pond Station 1<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Ned's Pond Station 2<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Ned's Pond Station 3<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Ned's Pond Station 4<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Ned's Pond Station 5<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Pond 2 Station 1<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Pond 2 Station 2<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Pond 2 Station 3<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Pond 2 Station 4<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 5-100 | 100.0 | 1.0 | 88.0 | 87.0 | 99.0 | 89.0 | 93.0 | 40.0 | 87.0 | 105.0 | 82.0 |
| Antimony | - | 6.0 | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Arsenic | 5.0 | 25.0 | 1.0 | < 1 | < 1 | < 1 | < 1 | < 1 | <1 | < 1 | < 1 | < 1 |
| Barium | - | 1000.0 | 1.0 | 14.0 | 16.0 | 15.0 | 15.0 | 15.0 | 29.0 | 15.0 | 16.0 | 16.0 |
| Beryllium | - | - | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Boron | - | 5000.0 | 1.0 | 5.0 | 5.0 | 6.0 | 6.0 | 6.0 | 10.0 | 6.0 | 5.0 | 6.0 |
| Cadmium | 0.0 | 5.0 | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Chromium | 8.9 | 50.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Cobalt | - | - | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Copper | 2-4 | 1000 (AO) | 1.0 | < 1 | < 1 | 1.0 | 1.0 | 1.0 | 1.0 | 2.0 | 1.0 | 1.0 |
| Iron | 300.0 | 300 (AO) | 0.1 | 180.0 | 180.0 | 180.0 | 180.0 | 180.0 | 110.0 | 170.0 | 160.0 | 150.0 |
| Lead | 1-7 | 10.0 | 0.1 | 1.2 | 0.3 | 1.6 | 0.6 | 1.4 | 0.3 | 3.4 | 5.3 | 3.4 |
| Manganese | - | 50 (AO) | 1.0 | 8.0 | 9.0 | 9.0 | 9.0 | 10.0 | 13.0 | 11.0 | 8.0 | 7.0 |
| Molybdenum | 73.0 | - | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | 0.1 | < 0.1 |
| Nickel | 25-150 | - | 1.0 | < 1 | < 1 | < 1 | < 1 | < 1 | <1 | < 1 | < 1 | < 1 |
| Selenium | 1.0 | 10.0 | 1.0 | 1.0 | < 1 | < 1 | < 1 | < 1 | <1 | < 1 | < 1 | 1.0 |
| Silver | 0.1 | - | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Strontium | - | - | 0.1 | 40.0 | 43.0 | 44.0 | 44.0 | 43.0 | 94.0 | 46.0 | 47.0 | 47.0 |
| Thallium | 0.8 | - | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Uranium | - | 20.0 | 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.2 | < 0.1 | < 0.1 | < 0.1 |
| Vanadium | - | - | 1.0 | < 1 | < 1 | < 1 | < 1 | < 1 | <1 | < 1 | < 1 | < 1 |
| Zinc | 30.0 | 5000 (AO) | 1.0 | 3.0 | 2.0 | 4.0 | 3.0 | 5.0 | 3.0 | 6.0 | 5.0 | 4.0 |
| Mercury | 0.1 | 1.0 | 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 0.1 | 0.1 | 0.1 | 0.1 |

**Table B.13: Surface Water Metals Chemistry**

| Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001)<br><br><br><br>ug/L | GCDWQ (2001)<br><br><br><br>ug/L | Pond 2 Station 5<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Black Duck Pond Station 1<br>Nov 22-01<br>Dec 11-01<br>RPC<br>ug/L | Black Duck Pond Station 2<br>Nov 22-01<br>Dec 11-01<br>RPC<br>ug/L | Black Duck Pond Station 3<br>Nov 22-01<br>Dec 11-01<br>RPC<br>ug/L | Black Duck Pond Station 4<br>Nov 22-01<br>Dec 11-01<br>RPC<br>ug/L | Black Duck Pond Station 5<br>Nov 22-01<br>Dec 11-01<br>RPC<br>ug/L | Control Pond 2 Station 1<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 5-100 | 100.0 | 80.0 | 82.0 | 87.0 | 82.0 | 85.0 | 83.0 | 10.0 |
| Antimony | - | 6.0 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Arsenic | 5.0 | 25.0 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Barium | - | 1000.0 | 16.0 | 6.0 | 7.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Beryllium | - | - | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Boron | - | 5000.0 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Cadmium | 0.0 | 5.0 | ***0.2*** | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Chromium | 8.9 | 50.0 | 2.0 | < 1 | 1.0 | < 1 | 2.0 | < 1 | 1.0 |
| Cobalt | - | - | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Copper | 2-4 | 1000 (AO) | ***12.0*** | < 1 | < 1 | 1.0 | < 1 | < 1 | < 1 |
| Iron | 300.0 | 300 (AO) | 160.0 | 160.0 | 160.0 | 170.0 | 140.0 | 160.0 | 50.0 |
| Lead | 1-7 | 10.0 | 3.3 | 2.6 | 2.6 | 1.9 | 0.7 | 1.2 | 1.1 |
| Manganese | - | 50 (AO) | 8.0 | 13.0 | 14.0 | 14.0 | 13.0 | 20.0 | **85.0** |
| Molybdenum | 73.0 | - | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.1 |
| Nickel | 25-150 | - | 2.0 | 1.0 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Selenium | 1.0 | 10.0 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Silver | 0.1 | - | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Strontium | - | - | 46.0 | 32.0 | 33.0 | 30.0 | 35.0 | 32.0 | 36.0 |
| Thallium | 0.8 | - | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Uranium | - | 20.0 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Vanadium | - | - | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| Zinc | 30.0 | 5000 (AO) | 29.0 | 5.0 | 3.0 | 7.0 | 3.0 | 4.0 | 3.0 |
| Mercury | 0.1 | 1.0 | ***0.4*** | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | < 0.05 |

**Table B.13: Surface Water Metals Chemistry**

| Date Sampled<br>Date Reported<br>Lab<br>Units | CCME (2001)<br><br><br><br>ug/L | GCDWQ (2001)<br><br><br><br>ug/L | Control Pond 2<br>Station 2<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Control Pond 2<br>Station 3<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Control Pond 2<br>Station 4<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L | Control Pond 2<br>Station 5<br>Nov 21-01<br>Dec 11-01<br>RPC<br>ug/L |
|---|---|---|---|---|---|---|
| Aluminum | 5-100 | 100.0 | 13.0 | 5.0 | 9.0 | 6.0 |
| Antimony | - | 6.0 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Arsenic | 5.0 | 25.0 | < 1 | < 1 | < 1 | < 1 |
| Barium | - | 1000.0 | 6.0 | 6.0 | 2.0 | 7.0 |
| Beryllium | - | - | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Boron | - | 5000.0 | 4.0 | 4.0 | 4.0 | 5.0 |
| Cadmium | 0.0 | 5.0 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Chromium | 8.9 | 50.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Cobalt | - | - | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Copper | 2-4 | 1000 (AO) | < 1 | < 1 | < 1 | < 1 |
| Iron | 300.0 | 300 (AO) | 60.0 | 50.0 | 20.0 | 50.0 |
| Lead | 1-7 | 10.0 | 6.3 | 1.6 | *10.6* | 3.4 |
| Manganese | - | 50 (AO) | **90.0** | **88.0** | 8.0 | **99.0** |
| Molybdenum | 73.0 | - | 0.1 | 0.1 | 0.2 | 0.2 |
| Nickel | 25-150 | - | < 1 | < 1 | < 1 | < 1 |
| Selenium | 1.0 | 10.0 | < 1 | < 1 | < 1 | < 1 |
| Silver | 0.1 | - | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Strontium | - | - | 37.0 | 38.0 | 47.0 | 37.0 |
| Thallium | 0.8 | - | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Uranium | - | 20.0 | < 0.1 | < 0.1 | 0.1 | < 0.1 |
| Vanadium | - | - | < 1 | < 1 | < 1 | < 1 |
| Zinc | 30.0 | 5000 (AO) | 5.0 | 2.0 | 4.0 | 3.0 |
| Mercury | 0.1 | 1.0 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |

Notes:
CCME (2001) - Canadian Water Quality Guidelines for the Protection of Aquatic Life (freshwater)
GCDWQ (2001) - Guidelines for Canadian Drinking Water Quality
AO - Drinking water quality Aesthetic Objective guideline
Highlighted and italicized values exceed CCME (2001)
Highlighted values exceed GCDWQ (2001)
Bolded and yellow highlighted values exceed both guidelines

**Table B.14: Fish Metals Chemistry**

| Sample<br>Sample Date<br>Date Reported<br>Lab<br>Units | CCME (2001)<br>Tissue Residue<br>Guidelines<br>mg/kg<br>diet wet weight | Detection Limit<br>RPC<br><br>mg/kg | Ned's Pond<br>Carcass 1<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Ned's Pond<br>Carcass 2<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Ned's Pond<br>Carcass 3<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Control Pond 2<br>Carcass 1<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Control Pond 2<br>Carcass 2<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Black Duck Pond<br>Carcass 1<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Pond 2<br>Carcass 1<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum | - | 0.01 | 2.1 | 5.26 | 2.15 | 2.33 | 1.56 | 36.8 | 4.26 |
| Antimony | - | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Arsenic | - | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 | <0.05 |
| Barium | - | 0.05 | 0.41 | 0.47 | 0.18 | 0.17 | 0.15 | 0.72 | 0.3 |
| Beryllium | - | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Boron | - | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium | - | 0.005 | 0.014 | 0.016 | <0.005 | 0.011 | 0.022 | 0.015 | 0.012 |
| Chromium | - | 0.05 | 0.64 | 0.18 | 0.38 | 0.27 | 0.09 | 2.07 | 0.19 |
| Cobalt | - | 0.005 | 0.044 | 0.036 | 0.013 | 0.012 | 0.014 | 0.067 | 0.03 |
| Copper | - | 0.05 | 1.84 | 0.62 | 0.77 | 0.8 | 0.6 | 0.78 | 0.66 |
| Iron | - | 1 | 18 | 73 | 17 | 17 | 12 | 68 | 23 |
| Lead | - | 0.005 | 0.091 | 0.048 | 0.021 | 0.11 | 0.026 | 0.052 | 0.037 |
| Manganese | - | 0.05 | 3.32 | 8.29 | 1.79 | 3.11 | 2.77 | 15.1 | 4.32 |
| Molybdenum | - | 0.005 | 0.105 | 0.041 | 0.071 | 0.045 | 0.022 | 0.351 | 0.048 |
| Nickel | - | 0.05 | 0.44 | 0.2 | 0.31 | 0.21 | 0.12 | 1.41 | 0.16 |
| Selenium | - | 0.05 | 0.3 | 0.24 | 0.16 | 0.27 | 0.24 | 0.42 | 0.39 |
| Silver | - | 0.005 | <0.005 | <0.005 | <0.005 | 0.008 | 0.015 | 0.006 | 0.007 |
| Strontium | - | 0.05 | 2.18 | 2.51 | 1.94 | 2.28 | 2.15 | 3.39 | 2.62 |
| Thallium | - | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.007 | <0.005 | <0.005 |
| Uranium | - | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Vanadium | - | 0.05 | <0.05 | 0.09 | <0.05 | <0.05 | <0.05 | 0.06 | <0.05 |
| Zinc | - | 0.05 | 20.6 | 20.5 | 21.1 | 24.6 | 21.2 | 20.4 | 19.6 |
| Mercury | 0.014 (methylmercury) | 0.002 | ***0.021*** | ***0.057*** | ***0.059*** | 0.019 | ***0.022*** | ***0.025*** | ***0.022*** |

**Table B.14: Fish Metals Chemistry**

| Sample<br>Sample Date<br>Date Reported<br>Lab<br>Units | CCME (2001)<br>Tissue Residue<br>Guidelines<br>mg/kg<br>diet wet weight | Pond 2 Carcass 1<br>(Dup)<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Ned's Pond<br>Fillet 1<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Ned's Pond<br>Fillet 2<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Ned's Pond<br>Fillet 3<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Control Pond 2<br>Fillet 1<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Control Pond 2 Fillet 1<br>(Dup)<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Control Pond 2<br>Fillet 2<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Black Duck Pond<br>Fillet 1<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum | - | 3.44 | 0.33 | 0.19 | 0.35 | 0.53 | 1.03 | 0.72 | 0.8 |
| Antimony | - | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Arsenic | - | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.09 |
| Barium | - | 0.27 | 0.06 | <0.05 | 0.05 | <0.05 | <0.05 | <0.05 | 0.05 |
| Beryllium | - | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Boron | - | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium | - | 0.012 | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Chromium | - | 0.26 | 0.27 | 0.29 | 0.16 | 0.34 | 0.32 | 0.19 | 0.07 |
| Cobalt | - | 0.031 | 0.015 | 0.013 | 0.008 | 0.013 | 0.014 | 0.01 | 0.019 |
| Copper | - | 0.68 | 0.35 | 0.28 | 0.44 | 0.67 | 0.66 | 0.48 | 0.36 |
| Iron | - | 21 | 5 | 5 | 3 | 5 | 5 | 5 | 5 |
| Lead | - | 0.035 | 0.013 | 0.016 | 0.017 | 0.055 | 0.052 | 0.052 | 0.026 |
| Manganese | - | 3.98 | 0.47 | 0.41 | 0.15 | 0.74 | 0.73 | 0.51 | 1.65 |
| Molybdenum | - | 0.054 | 0.048 | 0.05 | 0.028 | 0.052 | 0.05 | 0.031 | 0.015 |
| Nickel | - | 0.22 | 0.22 | 0.2 | 0.14 | 0.2 | 0.19 | 0.14 | 0.09 |
| Selenium | - | 0.37 | 0.22 | 0.16 | 0.14 | 0.18 | 0.22 | 0.15 | 0.34 |
| Silver | - | 0.006 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Strontium | - | 2.34 | 0.28 | 0.28 | 0.13 | 0.37 | 0.34 | 0.25 | 0.57 |
| Thallium | - | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Uranium | - | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Vanadium | - | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Zinc | - | 19.8 | 6.03 | 6.21 | 5.65 | 10.6 | 10.6 | 9.23 | 8.43 |
| Mercury | 0.014 (methylmercury) | ***0.023*** | ***0.025*** | ***0.079*** | ***0.091*** | ***0.026*** | ***0.025*** | ***0.033*** | ***0.031*** |

**Table B.14: Fish Metals Chemistry**

| Sample<br>Sample Date<br>Date Reported<br>Lab<br>Units | CCME (2001)<br>Tissue Residue<br>Guidelines<br>mg/kg<br>diet wet weight | Pond 2<br>Fillet 1<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Pond 2 Fillet 1<br>(Dup)<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Mean Carcass<br>Concentrations<br>Ned's Pond<br>and Pond #2<br>mg/kg | Mean Carcass<br>Concentrations<br>Reference Areas<br>mg/kg | Mean Fillet<br>Concentrations<br>Ned's Pond<br>and Pond #2<br>mg/kg | Mean Fillet<br>Concentrations<br>Reference Areas<br>mg/kg |
|---|---|---|---|---|---|---|---|
| Aluminum | - | 0.71 | 0.82 | 3.442 | 13.5633 | 0.48 | 0.77 |
| Antimony | - | <0.05 | <0.05 | nd | nd | nd | nd |
| Arsenic | - | 0.05 | 0.05 | nd | 0.0500 | 0.05 | 0.09 |
| Barium | - | 0.08 | 0.07 | 0.326 | 0.3467 | 0.065 | 0.05 |
| Beryllium | - | <0.005 | <0.005 | nd | nd | nd | nd |
| Boron | - | <0.05 | <0.05 | nd | nd | nd | nd |
| Cadmium | - | <0.005 | <0.005 | 0.0135 | 0.0160 | 0.005 | nd |
| Chromium | - | 0.14 | 0.16 | 0.33 | 0.8100 | 0.204 | 0.23 |
| Cobalt | - | 0.014 | 0.016 | 0.0308 | 0.0310 | 0.0132 | 0.014 |
| Copper | - | 0.35 | 0.39 | 0.914 | 0.7267 | 0.362 | 0.5425 |
| Iron | - | 4 | 5 | 30.4 | 32.3333 | 4.4 | 5 |
| Lead | - | 0.022 | 0.03 | 0.0464 | 0.0627 | 0.0196 | 0.04625 |
| Manganese | - | 0.95 | 0.88 | 4.34 | 6.9933 | 0.572 | 0.9075 |
| Molybdenum | - | 0.023 | 0.021 | 0.0638 | 0.1393 | 0.034 | 0.037 |
| Nickel | - | 0.09 | 0.1 | 0.266 | 0.5800 | 0.15 | 0.155 |
| Selenium | - | 0.26 | 0.3 | 0.292 | 0.3100 | 0.216 | 0.2225 |
| Silver | - | <0.005 | <0.005 | 0.0065 | 0.0097 | nd | nd |
| Strontium | - | 0.51 | 0.44 | 2.318 | 2.6067 | 0.328 | 0.3825 |
| Thallium | - | <0.005 | <0.005 | nd | 0.0070 | nd | nd |
| Uranium | - | <0.005 | <0.005 | nd | 0.0000 | nd | nd |
| Vanadium | - | <0.05 | <0.05 | 0.09 | 0.0600 | nd | nd |
| Zinc | - | 8.65 | 9.27 | 20.32 | 22.0667 | 7.162 | 9.715 |
| Mercury | 0.014 (methylmercury) | *0.033* | *0.032* | 0.0364 | 0.0220 | 0.052 | 0.02875 |

Notes:
CCME (2001) - Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota
Highlighted and italicized values indicate exceedences of CCME (2001)
Shaded values indicate highest average concentration in fillets
or carcasses (in Ned's Pond and Pond #2 in comparison to the reference areas)

**Table B.14: Fish Metals Chemistry**

| Sample<br>Sample Date<br>Date Reported<br>Lab<br>Units | CCME (2001)<br>Tissue Residue<br>Guidelines<br>mg/kg<br>diet wet weight | Pond 2<br>Fillet 1<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Pond 2 Fillet 1<br>(Dup)<br>Dec 13-01<br>Jan-09-02<br>RPC<br>mg/kg | Mean Carcass<br>Concentrations<br>Ned's Pond<br>and Pond #2<br>mg/kg | Mean Carcass<br>Concentrations<br>Reference Areas<br>mg/kg | Mean Fillet<br>Concentrations<br>Ned's Pond<br>and Pond #2<br>mg/kg | Mean Fillet<br>Concentrations<br>Reference Areas<br>mg/kg |
|---|---|---|---|---|---|---|---|
| Aluminum | - | 0.71 | 0.82 | 3.442 | 13.5633 | 0.48 | 0.77 |
| Antimony | - | <0.05 | <0.05 | nd | nd | nd | nd |
| Arsenic | - | 0.05 | 0.05 | nd | 0.0500 | 0.05 | 0.09 |
| Barium | - | 0.08 | 0.07 | 0.326 | 0.3467 | 0.065 | 0.05 |
| Beryllium | - | <0.005 | <0.005 | nd | nd | nd | nd |
| Boron | - | <0.05 | <0.05 | nd | nd | nd | nd |
| Cadmium | - | <0.005 | <0.005 | 0.0135 | 0.0160 | 0.005 | nd |
| Chromium | - | 0.14 | 0.16 | 0.33 | 0.8100 | 0.204 | 0.23 |
| Cobalt | - | 0.014 | 0.016 | 0.0308 | 0.0310 | 0.0132 | 0.014 |
| Copper | - | 0.35 | 0.39 | 0.914 | 0.7267 | 0.362 | 0.5425 |
| Iron | - | 4 | 5 | 30.4 | 32.3333 | 4.4 | 5 |
| Lead | - | 0.022 | 0.03 | 0.0464 | 0.0627 | 0.0196 | 0.04625 |
| Manganese | - | 0.95 | 0.88 | 4.34 | 6.9933 | 0.572 | 0.9075 |
| Molybdenum | - | 0.023 | 0.021 | 0.0638 | 0.1393 | 0.034 | 0.037 |
| Nickel | - | 0.09 | 0.1 | 0.266 | 0.5800 | 0.15 | 0.155 |
| Selenium | - | 0.26 | 0.3 | 0.292 | 0.3100 | 0.216 | 0.2225 |
| Silver | - | <0.005 | <0.005 | 0.0065 | 0.0097 | nd | nd |
| Strontium | - | 0.51 | 0.44 | 2.318 | 2.6067 | 0.328 | 0.3825 |
| Thallium | - | <0.005 | <0.005 | nd | 0.0070 | nd | nd |
| Uranium | - | <0.005 | <0.005 | nd | 0.0000 | nd | nd |
| Vanadium | - | <0.05 | <0.05 | 0.09 | 0.0600 | nd | nd |
| Zinc | - | 8.65 | 9.27 | 20.32 | 22.0667 | 7.162 | 9.715 |
| Mercury | 0.014 (methylmercury) | *0.033* | *0.032* | 0.0364 | 0.0220 | 0.052 | 0.02875 |

Notes:
CCME (2001) - Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota
Highlighted and italicized values indicate exceedences of CCME (2001)
Shaded values indicate highest average concentration in fillets
or carcasses (in Ned's Pond and Pond #2 in comparison to the reference areas)

**Table B.15: Fish Weights**

| Location | Subsample (if applicable) | Sample | Weight (g) | Total Fish Weight (g) |
|---|---|---|---|---|
| Ned's Pond | Subsample #1 | 3 fillets | 98.7 | |
| Ned's Pond | Subsample #1 | 3 carcasses | 100 | 198.7 |
| Ned's Pond | Subsample #2 | 3 fillets | 144 | |
| Ned's Pond | Subsample #2 | 3 carcasses | 193 | 337 |
| Ned's Pond | Subsample #3 | 1 fillet | 87 | |
| Ned's Pond | Subsample #3 | 1 carcass | 19.7 | 106.7 |
| Pond 2 | | 1 fillet | 109.8 | |
| Pond 2 | | 1 carcass | 122 | 231.8 |
| Black Duck Pond | | 1 fillet | 80.6 | |
| Black Duck Pond | | 1 carcass | 99.4 | 180 |
| Control Pond 2 | Subsample #1 | 7 fillets | 102.6 | |
| Control Pond 2 | Subsample #1 | 7 carcasses | 114.2 | 216.8 |
| Control Pond 2 | Subsample #2 | 6 fillets | 118.2 | |
| Control Pond 2 | Subsample #2 | 6 carcasses | 125.2 | 243.4 |

# APPENDIX C

# ANALYTICAL PACKAGE PARAMETERS

**Table C.1: Analytical Package Parameters**

| Analysis | Parameters |
|---|---|
| Alberta MUST<br>(Philip Analytical Services - PAS)<br>(Research and Productivity Council - RPC) | Benzene |
| | Toluene |
| | Ethylbenzene |
| | Xylenes |
| | Total Petroleum Hydrocarbons (TPH) C6-C10 |
| | TPH C11-C20 |
| | TPH C21-C32 |
| (Environmental Canada Lab - ECB)<br>Canada Wide Standard | TPH C10-C16 |
| | TPH C16-C34 |
| | TPH C34-C50 |
| Available Trace Metals<br>(PAS, RPC) | Aluminum |
| | Antimony |
| | Arsenic |
| | Barium |
| | Beryllium |
| | Boron |
| | Cadmium |
| | Chromium |
| | Cobalt |
| | Copper |
| | Iron |
| | Lead |
| | Manganese |
| | Molybdenum |
| | Nickel |
| | Selenium |
| | Silver |
| | Strontium |
| | Thallium |
| | Uranium |
| | Vanadium |
| | Zinc |
| | Mercury |
| ICPMS/S metals scan<br>(ECB) | Antimony |
| | Arsenic |
| | Cadmium |
| | Chromium |
| | Cobalt |
| | Copper |
| | Lead |
| | Manganese |
| | Molybdenum |
| | Nickel |
| | Silver |
| | Tin |
| | Vanadium |
| | Zinc |
| | Mercury |
| Polcyclic Aromatic Hydrocarbons (PAHs)<br>(PAS) | Naphthalene |
| | Perylene |
| | 1-Methylnaphthalene |
| | 2-Methylnaphthalene |
| | Acenaphthylene |
| | Acenaphthene |
| | Fluorene |
| | Phenanthrene |
| | Anthracene |
| | Fluoranthene |
| | Pyrene |

**Table C.1: Analytical Package Parameters**

| Analysis | Parameters |
|---|---|
| | Benzo(a)anthracene |
| | Chrysene |
| | Benzo(b)fluoranthene |
| | Benzo(k)fluoranthene |
| | Benzo(a)pyrene |
| | Indeno(1,2,3-cd)pyrene |
| | Dibenz(a,h)anthracene |
| | Benzo(g,h,i)perylene |
| | 1-Chloronaphthalene |
| PAHs (RPC) | Naphthalene |
| | Acenaphthylene |
| | Acenaphthene |
| | Fluorene |
| | Phenanthrene |
| | Anthracene |
| | Fluoranthene |
| | Pyrene |
| | Benzo(a)anthracene |
| | Chrysene/Triphenylene |
| | Benzo(b+k)fluoranthene |
| | Benzo(e)pyrene |
| | Benzo(a)pyrene |
| | Indeno(1,2,3-cd)pyrene |
| | Benzo(g,h,i)perylene |
| | Dibenz(a,h)anthracene |
| PAHs (ECB) | Naphthalene |
| | Acenaphthylene |
| | Acenaphthene |
| | Fluorene |
| | Phenanthrene |
| | Anthracene |
| | Fluoranthene |
| | Pyrene |
| | Benzo(a)anthracene |
| | Chrysene |
| | Benzo(b)fluoranthene |
| | Benzo(k)fluoranthene |
| | Benzo(a)pyrene |
| | Indeno(1,2,3-cd)pyrene |
| | Dibenz(a,h)anthracene |
| | Benzo(g,h,i)perylene |
| Organochlorine Pesticides (PAS) | Alpha BHC |
| | Gamma BHC (Lindane) |
| | Heptachlor |
| | Aldrin |
| | Heptachlor Epoxide |
| | Alpha-Endosulfan |
| | Para-Para DDE |
| | Endrin |
| | Beta-Endosulfan |
| | Para-Para DDD |
| | Ortho-Para DDT |
| | Para-Para DDT |
| | Mirex |
| | Chlordane |
| | Dieldrin |
| | Methoxychlor |
| | Hexachlorobenzene |
| | Beta-BHC |

**Table C.1: Analytical Package Parameters**

| Analysis | Parameters |
|---|---|
| | Delta-BHC |
| | Endrin Aldehyde |
| | Endrin Ketone |
| | Ortho-Para DDD |
| | Ortho-Para DDE |
| | Toxaphene |
| | Endosulfan Sulfate |
| Organochlorine Pesticides (RPC) | Aldrin |
| | Dieldrin |
| | Alpha BHC |
| | Beta-BHC |
| | Gamma BHC (Lindane) |
| | Delta-BHC |
| | Para-Para DDD |
| | Para-Para DDE |
| | Para-Para DDT |
| | Endosulfan I |
| | Endosulfan II |
| | Endosulfan sulfate |
| | Endrin |
| | Endrin Aldehyde |
| | Endrin Ketone |
| | Heptachlor |
| | Heptachlor Epoxide |
| | Methoxychlor |
| | Aroclor 1242 (PCB) |
| | Aroclor 1254 |
| | Aroclor 1260 |
| Organochlorine Pesticides (ECB) | Aldrin |
| | Alpha BHC |
| | Alpha Chlordane |
| | Gamma Chlordane |
| | Ortho-Para DDD |
| | Para-Para DDD |
| | Ortho-Para DDE |
| | Para-Para DDE |
| | Ortho-Para DDT |
| | Para-Para DDT |
| | Dieldrin |
| | Alpha-Endosulfan |
| | Beta-Endosulfan |
| | Endrin |
| | Heptachlor Epoxide |
| | Gamma BHC |
| | Methoxychlor |
| | Mirex |
| Polychlorinated Biphenyls (PCBs) | Total PCBs |
| Volatile Organic Compounds (VOCs) | Chloromethane |
| | Vinyl Chloride |
| | Bromomethane |
| | Trichlorofluoromethane |
| | 1,1-Dichloroethylene |
| | Dichloromethane |
| | Trans-1,2-Dichlorethylene |
| | 1,1-Dichloroethane |
| | Cis-1,2-Dichloroethylene |
| | Chlorobromomethane |
| | Chloroform |
| | 1,2-Dichloroethane |

**Table C.1: Analytical Package Parameters**

| Analysis | Parameters |
|---|---|
| | 1,1,1-Trichloroethane |
| | Benzene |
| | Carbon Tetrachloride |
| | 1,2-Dichloropropane |
| | Bromodichloromethane |
| | Trichloroethylene |
| | Cis-1,3-Dichloropropene |
| | Trans-1,3-Dichloropropene |
| | 1,1,2-Trichloroethane |
| | Toluene |
| | Chlorodibromomethane |
| | 1,2-Dibromomethane |
| | Tetrachloroethylene |
| | Chlorobenzene |
| | Ethylbenzene |
| | Bromoform |
| | m&p-Xylenes |
| | Styrene |
| | 1,1,2,2-Tetrachloroethane |
| | o-Xylenes |
| | 1,3-Dichlorobenzene |
| | 1,4-Dichlorobenzene |
| | 1,2-Dichlorobenzene |

# APPENDIX D

# APPLICABLE EQUATIONS

**Table D.1: Fish Ingestion Equations**

| Parameter | Maximum Concentration in Fish mg/kg | Adult TDI mg/day | Toddler TDI mg/day | Adult ADI mg/day | Toddler ADI mg/day | Adult RDI mg/day | Toddler RDI mg/day | Acceptable Adult Ingestion of Fish kg/year | Acceptable Toddler Ingestion of Fish kg/year | Acceptable Adult Ingestion of Fish kg/day | Acceptable Toddler Ingestion of Fish kg/day |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acenaphthene | 0.01 | 4.2 | 0.78 | 0 | 0 | 4.2 | 0.78 | 153300 | 28470 | 420 | 78 |
| Barium | 0.47 | 4.9 | 0.91 | 1.3 | 0.241428571 | 3.6 | 0.668571429 | 2795.744681 | 519.209726 | 7.659574468 | 1.422492401 |
| Cadmium | 0.016 | 0.07 | 0.013 | 0.0154 | 0.0042 | 0.0546 | 0.0088 | 1245.5625 | 200.75 | 3.4125 | 0.55 |
| Copper | 1.84 | 2.8 | 0.52 | 0.9 | 0.167142857 | 1.9 | 0.352857143 | 376.9021739 | 69.996118 | 1.032608696 | 0.191770186 |
| Mercury | 0.091 | 0.007 | 0.0013 | 0.00182 | 0.00204 | 0.00518 | -0.00074 | 20.77692308 | -2.96813187 | 0.056923077 | -0.008131868 |
| Mercury (ref area) | 0.033 | 0.007 | 0.0013 | 0.00182 | 0.00204 | 0.00518 | -0.00074 | 57.29393939 | -8.18484848 | 0.156969697 | -0.022424242 |
| Vanadium | 0.09 | 0.49 | 0.091 | 0.03 | 0.005571429 | 0.46 | 0.085428571 | 1865.555556 | 346.460317 | 5.111111111 | 0.949206349 |

TDI - tolerable daily intake
ADI - average daily intake
RDI - residual daily intake

**Table D.2: Predicted Sediment Pore Water Concentrations from Sediment Concentrations**

| Parameter | Coc mg/kg | Koc L/kg | foc* % | Kp L/kg | Cd mg/L |
|---|---|---|---|---|---|
| Lead | 43 | n/a | 0.225 | 9.00E+02 | 4.78E-02 |

*Mean foc value for Ned's Pond and Pond #2

**Table D.3: BSAF Calculations for Sediment POCs**

| Parameter | Constant | Kow | LogKow | Constant | Log BSAF | BSAF |
|---|---|---|---|---|---|---|
| Toluene | 0.819 | 4.65E+02 | 2.667452953 | 1.146 | 1.038643968 | 10.93059916 |
| Xylenes | 0.819 | 1.35E+03 | 3.130333768 | 1.146 | 1.417743356 | 26.16636266 |

**Table D.4: Predicted Benthic Infauna POC Concentrations Based on Sediment POC Concentrations**

| Parameter | Sediment Concentration (95th UCL Where Calculated) (mg/kg) | Total Organic Carbon (TOC) (g oc/g sediment) | TOC - Normalized Sediment Concentration oc) | Invertebrate BSAF (Sample, et. al., 1996) | Invertebrate Concentration lipid) | Invertebrate Lipid Content (Cantox, 1996) (g lipid/g tissue) | Invertebrate Concentration (mg chem/g tissue) |
|---|---|---|---|---|---|---|---|
| Acenaphthene | 9.70E-03 | 2.25E-01 | 4.31E-02 | 3.20E-01 | 1.38E-02 | 1.50E-02 | 2.07E-04 |
| Aluminum | 3 90E+04 | 2.25E-01 | 1.73E+05 | 3.00E-01 | 5.20E+04 | 1.50E-02 | 7.80E+02 |
| Available Aluminu | 1.40E+04 | 2.25E-01 | 6.22E+04 | 3.00E-01 | 1.87E+04 | 1.50E-02 | 2.80E+02 |
| Barium | 2.50E+02 | 2.25E-01 | 1.11E+03 | 9.00E-01 | 1.00E+03 | 1.50E-02 | 1.50E+01 |
| Cadmium | 8.40E-01 | 2.25E-01 | 3.73E+00 | 3.40E+00 | 1.27E+01 | 1.50E-02 | 1.90E-01 |
| Copper | 3.50E+01 | 2.25E-01 | 1.56E+02 | 3.00E-01 | 4.67E+01 | 1.50E-02 | 7.00E-01 |
| Lead | 3.80E+01 | 2.25E-01 | 1.69E+02 | 6.30E-01 | 1.06E+02 | 1.50E-02 | 1.60E+00 |
| Strontium | 9.60E+01 | 2.25E-01 | 4.27E+02 | 9.00E-01 | 3.84E+02 | 1.50E-02 | 5.76E+00 |
| Mercury | 1.40E-01 | 2.25E-01 | 6.22E-01 | 4.80E-01 | 2.99E-01 | 1.50E-02 | 4.48E-03 |
| Toluene | 6.00E-02 | 2.25E-01 | 2.67E-01 | 1.60E-02 | 4.27E-03 | 1.50E-02 | 6.40E-05 |
| Xylenes | 1.20E-01 | 2.25E-01 | 5.33E-01 | 1.50E-01 | 8.00E-02 | 1.50E-02 | 1.20E-03 |
| Vanadium | 8.70E+01 | 2.25E-01 | 3.87E+02 | 3.00E-01 | 1.16E+02 | 1.50E-02 | 1.74E+00 |

**Table D.5: Average Daily Surface Water POC Intake (Ducks)**

| Parameter | Surface Water Concentration (95th UCL Where Calculated) mg/L | Average Daily Water Ingestion Rate (Mallard Duckling) L/day | Average Daily POC Intake from Water Ingestion mg/day |
|---|---|---|---|
| Aluminum | 9.60E-02 | 8.34E-02 | 8.01E-03 |
| Barium | 1.90E-02 | 8.34E-02 | 1.58E-03 |
| Lead | 3.10E-03 | 8.34E-02 | 2.59E-04 |
| Strontium | 5.90E-02 | 8.34E-02 | 4.92E-03 |

**Table D.6: Average Daily Sediment POC Intake (Ducks)**

| Parameter | Sediment Concentration (95th UCL Where Calculated) mg/kg | Average Daily Sediment Ingestion Rate (3.3% of total diet of 0.0782 kg/day) (Beyer et. Al., 1994; Heinz et. Al., 1989) kg/day | Average Daily POC Intake from Sediment Ingestion mg/day |
|---|---|---|---|
| Aluminum | 3.90E+04 | 2.58E-03 | 1.01E+02 |
| Barium | 2.50E+02 | 2.58E-03 | 6.45E-01 |
| Lead | 3.80E+01 | 2.58E-03 | 9.81E-02 |
| Strontium | 9.60E+01 | 2.58E-03 | 2.48E-01 |
| Toluene | 6.00E-02 | 2.58E-03 | 1.55E-04 |
| Xylenes | 1.20E-01 | 2.58E-03 | 3.10E-04 |

**Table D.7: Average Daily Benthic Infauna POC Intake (Ducks)**

| Parameter | Predicted Concentration in Benthic Invertebrates tissue) | Average Daily Food Ingestion Rate (96.7% of total diet of 0.0782 kg/day) kg/day | Average Daily POC Intake from Ingestion of Benthic Infauna mg/day |
|---|---|---|---|
| Aluminum | 7.80E+02 | 7.56E-02 | 5.90E+01 |
| Barium | 1.50E+01 | 7.56E-02 | 1.13E+00 |
| Lead | 1.60E+00 | 7.56E-02 | 1.21E-01 |
| Strontium | 5.76E+00 | 7.56E-02 | 4.36E-01 |
| Toluene | 6.40E-05 | 7.56E-02 | 4.84E-06 |
| Xylenes | 1.20E-03 | 7.56E-02 | 9.07E-05 |

**Table D.8: Average Daily POC Intake from Surface Water, Sediment and Benthic Infauna Ingestion (Ducks) (mg/kg bw/day)**

| Parameter | Average Daily POC Intake from Water Ingestion mg/day | Average Daily POC Intake from Sediment Ingestion mg/day | Average Daily POC Intake from Food Ingestion (Benthic Infauna) mg/day | Average Daily POC Intake From Water, Sediment and Benthic Infauna mg/day | Average Daily POC Intake - Adult Ducks (assuming 1 kg body weight) (Heniz et. Al., 1989) mg/kg-bw/day | Average Daily POC Intake - Ducklings (assuming 0.782 kg body weight) (Heinz et. Al., 1989) mg/kg-bw/day |
|---|---|---|---|---|---|---|
| Aluminum | 8.01E-03 | 1.01E+02 | 5.90E+01 | 1.60E+02 | 1.60E+02 | 1.25E+02 |
| Barium | 1.58E-03 | 6.45E-01 | 1.13E+00 | 1.78E+00 | 1.78E+00 | 1.39E+00 |
| Lead | 2.59E-04 | 9.81E-02 | 1.21E-01 | 2.19E-01 | 2.19E-01 | 1.71E-01 |
| Strontium | 4.92E-03 | 2.48E-01 | 4.36E-01 | 6.88E-01 | 6.88E-01 | 5.38E-01 |
| Toluene | 0.00E+00 | 1.55E-04 | 4.84E-06 | 1.60E-04 | 1.60E-04 | 1.25E-04 |
| Xylenes | 0.00E+00 | 3.10E-04 | 9.07E-05 | 4.00E-04 | 4.00E-04 | 3.13E-04 |

**Table D.9: Average Daily Surface Water POC Intake (Mink)**

| Parameter | Surface Water Concentration (95th UCL Where Calculated) mg/L | Average Daily Water Ingestion Rate (Mink) L/day | Average Daily POC Intake from Water Ingestion (Mink) mg/day |
|---|---|---|---|
| Acenaphthene | nd | 9.90E-02 | nd |
| Aluminum | 9.60E-02 | 9.90E-02 | 9.50E-03 |
| Barium | 1.90E-02 | 9.90E-02 | 1.88E-03 |
| Cadmium | 9.80E-05 | 9.90E-02 | 9.70E-06 |
| Copper | 2.00E-03 | 9.90E-02 | 1.98E-04 |
| Lead | 3.10E-03 | 9.90E-02 | 3.07E-04 |
| Strontium | 5.90E-02 | 9.90E-02 | 5.84E-03 |
| Vanadium | nd | 9.90E-02 | nd |
| Mercury | 1.00E-04 | 9.90E-02 | 9.90E-06 |

**Table D.10: Average Daily Sediment POC Intake (Mink)**

| Parameter | Sediment Concentration (95th UCL Where Calculated) mg/kg | Average Daily Sediment Ingestion Rate (3.3% of total diet of 0.137 kg/day) (same as used for ducks) kg/day | Average Daily POC Intake from Sediment Ingestion mg/day |
|---|---|---|---|
| Acenaphthene | 9.70E-03 | 4.52E-03 | 4.39E-05 |
| Aluminum | 3.90E+04 | 4.52E-03 | 1.76E+02 |
| Available Aluminum | 1.40E+04 | 4.52E-03 | 6.33E+01 |
| Barium | 2.50E+02 | 4.52E-03 | 1.13E+00 |
| Cadmium | 8.40E-01 | 4.52E-03 | 3.80E-03 |
| Copper | 3.50E+01 | 4.52E-03 | 1.58E-01 |
| Lead | 3.80E+01 | 4.52E-03 | 1.72E-01 |
| Strontium | 9.60E+01 | 4.52E-03 | 4.34E-01 |
| Vanadium | 8.70E+01 | 4.52E-03 | 3.93E-01 |
| Mercury | 1.40E-01 | 4.52E-03 | 6.33E-04 |
| Toluene | 6.00E-02 | 4.52E-03 | 2.71E-04 |
| Xylenes | 1.20E-01 | 4.52E-03 | 5.43E-04 |

**Table D.11: Average Daily Benthic Infauna POC Intake (Mink)**

| Parameter | Predicted Concentration in Benthic Invertebrates (mg chem/kg tissue) | Average Daily Benthic Infauna Ingestion Rate (25% of total diet of 0.137 kg/day) kg/day | Average Daily POC Intake from Ingestion of Benthic Infauna mg/day |
|---|---|---|---|
| Acenaphthene | 2.07E-04 | 3.43E-02 | 7.09E-06 |
| Aluminum | 7.80E+02 | 3.43E-02 | 2.67E+01 |
| Available Aluminum | 2.80E+02 | 3.43E-02 | 9.59E+00 |
| Barium | 1.50E+01 | 3.43E-02 | 5.14E-01 |
| Cadmium | 1.90E-01 | 3.43E-02 | 6.52E-03 |
| Copper | 7.00E-01 | 3.43E-02 | 2.40E-02 |
| Lead | 1.60E+00 | 3.43E-02 | 5.47E-02 |
| Strontium | 5.76E+00 | 3.43E-02 | 1.97E-01 |
| Vanadium | 1.74E+00 | 3.43E-02 | 5.96E-02 |
| Mercury | 4.48E-03 | 3.43E-02 | 1.53E-04 |
| Toluene | 6.40E-05 | 3.43E-02 | 2.19E-06 |
| Xylenes | 1.20E-03 | 3.43E-02 | 4.11E-05 |

**Table D.12: Average Daily Fish POC Intake (Mink)**

| Parameter | Mean Concentration in Fish mg/kg | Average Daily Fish Ingestion Rate kg/day | Average Daily POC Intake from Fish Ingestion |
|---|---|---|---|
| Acenaphthene | 1.00E-02 | 6.00E-02 | 6.00E-04 |
| Aluminum | 3.44E+00 | 6.00E-02 | 2.06E-01 |
| Barium | 3.26E-01 | 6.00E-02 | 1.96E-02 |
| Cadmium | 1.35E-02 | 6.00E-02 | 8.10E-04 |
| Copper | 9.14E-01 | 6.00E-02 | 5.48E-02 |
| Lead | 4.64E-02 | 6.00E-02 | 2.78E-03 |
| Strontium | 2.32E+00 | 6.00E-02 | 1.39E-01 |
| Mercury | 5.20E-02 | 6.00E-02 | 3.12E-03 |
| Vanadium | 9.00E-02 | 6.00E-02 | 5.40E-03 |

**Table D.13: Average Daily POC Intake from Surface Water, Sediment,Benthic Infauna and Fish Ingestion (Mink) (mg/kg-bw/day)**

| Parameter | Average Daily POC Intake from Water Ingestion mg/day | Average Daily POC Intake from Sediment Ingestion mg/day | Average Daily POC Intake from Benthic Infauna mg/day | Average Daily POC Intake from Fish Ingestion mg/day | Contaminant Intake From Water, Sediment, Benthic Invertebrates and Fish mg/day | Average Daily Intake - Mink (assuming 1 kg body weight) (Sample et. Al., 1996) mg/kg-bw/day |
|---|---|---|---|---|---|---|
| Acenaphthene | 0.00E+00 | 4.39E-05 | 7.09E-06 | 6.00E-04 | 6.51E-04 | 6.51E-04 |
| Aluminum | 9.50E-03 | 1.76E+02 | 2.67E+01 | 2.06E-01 | 2.03E+02 | 2.03E+02 |
| Available Aluminum | 9.50E-03 | 6.33E+01 | 9.59E+00 | 2.06E-01 | 7.31E+01 | 7.31E+01 |
| Barium | 1.88E-03 | 1.13E+00 | 5.14E-01 | 1.96E-02 | 1.67E+00 | 1.67E+00 |
| Cadmium | 9.70E-06 | 3.80E-03 | 6.52E-03 | 8.10E-04 | 1.11E-02 | 1.11E-02 |
| Copper | 1.98E-04 | 1.58E-01 | 2.40E-02 | 5.48E-02 | 2.37E-01 | 2.37E-01 |
| Lead | 3.07E-04 | 1.72E-01 | 5.47E-02 | 2.78E-03 | 2.30E-01 | 2.30E-01 |
| Strontium | 5.84E-03 | 4.34E-01 | 1.97E-01 | 1.39E-01 | 7.76E-01 | 7.76E-01 |
| Vanadium | nd | 3.93E-01 | 5.96E-02 | 5.40E-03 | 4.58E-01 | 4.58E-01 |
| Mercury | 9.90E-06 | 6.33E-04 | 1.53E-04 | 3.12E-03 | 3.92E-03 | 3.92E-03 |
| Toluene | 0.00E+00 | 2.71E-04 | 2.19E-06 | n/a | 2.73E-04 | 2.73E-04 |
| Xylenes | 0.00E+00 | 5.43E-04 | 4.11E-05 | n/a | 5.84E-04 | 5.84E-04 |

Site Name: Stephenville UAS
Site Location: Stephenville, Newfoundland

Completed By: Allison Denning
Date Completed: 7/2/2010



**SCREEN 7.2 SEDIMENT CONCENTRATION CALCULATOR**

## TIER 2 SEDIMENT CONCENTRATION DATA SUMMARY

| CONSTITUENTS DETECTED | | Analytical Method | | | Detected Concentrations | | | Calculated Distribution of Data | Default Detection Limit |
|---|---|---|---|---|---|---|---|---|---|
| CAS No. | Name | Typical Detection Limit (mg/kg) | No. of Samples | No. of Detects | Maximum Conc. (mg/kg) | Mean Conc. (mg/kg) | UCL on Mean Conc. (mg/kg) | | (mg/kg) |
| 83-32-9 | Acenaphthene | 1.0E-02 | 22 | 10 | 1.0E-01 | 7.6E-03 | 9.7E-03 | Lognormal | 0.01 |
| 7429-90-5 | Aluminum | 1.0E+00 | 22 | 22 | 6.7E+04 | 3.2E+04 | 3.9E+04 | Normal | 1 |
| 7429-90-5 | Aluminum (available) | 1.0E+00 | 4 | 4 | 1.5E+04 | 1.4E+04 | 1.5E+04 | Normal | 1 |
| 86-73-7 | Fluorene | 1.0E-02 | 22 | 14 | 1.4E-01 | 9.8E-03 | 1.3E-02 | Lognormal | 0.01 |
| 7440-39-3 | Barium | 1.0E-02 | 22 | 22 | 3.8E+02 | 2.1E+02 | 2.5E+02 | Normal | 0.01 |
| 29-59-3 | Phenanthrene | 1.0E-02 | 22 | 18 | 8.7E-01 | 4.1E-02 | 6.7E-02 | Lognormal | 0.01 |
| 120-12-7 | Anthracene | 1.0E-02 | 22 | 15 | 2.3E-01 | 1.2E-02 | 1.8E-02 | Lognormal | 0.01 |
| 206-44-0 | Fluoranthene | 1.0E-02 | 22 | 18 | 9.1E-01 | 5.1E-02 | 8.5E-02 | Lognormal | 0.01 |
| 129-00-0 | Pyrene | 1.0E-02 | 22 | 18 | 6.9E-01 | 3.9E-02 | 6.4E-02 | Lognormal | 0.01 |
| 7440-43-9 | Cadmium | 1.0E-02 | 22 | 21 | 1.2E+00 | 7.0E-01 | 8.4E-01 | Normal | 0.01 |
| 56-55-3 | Benzo(a)anthracene | 1.0E-02 | 22 | 18 | 2.8E-01 | 2.0E-02 | 3.0E-02 | Lognormal | 0.01 |
| 218-01-9 | Chrysene | 1.0E-02 | 22 | 18 | 4.4E-01 | 2.6E-02 | 4.0E-02 | Lognormal | 0.01 |
| 205-99-2 | Benzo(b)fluoranthene | 1.0E-02 | 22 | 18 | 2.6E-01 | 2.3E-02 | 3.5E-02 | Lognormal | 0.01 |
| 207-08-9 | Benzo(k)fluoranthene | 1.0E-02 | 22 | 18 | 2.6E-01 | 2.3E-02 | 3.4E-02 | Lognormal | 0.01 |
| 50-32-8 | Benzo(a)pyrene | 1.0E-02 | 22 | 11 | 2.8E-01 | 1.3E-02 | 2.1E-02 | Lognormal | 0.01 |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 1.0E-02 | 22 | 11 | 1.9E-01 | 1.3E-02 | 2.0E-02 | Lognormal | 0.01 |
| 53-70-3 | Dibenz(a,h)anthracene | 1.0E-02 | 22 | 4 | 6.0E-02 | 6.6E-03 | 8.6E-03 | Lognormal | 0.01 |
| 7439-97-6 | Mercury | 1.0E-02 | 22 | 22 | 2.0E-01 | 1.2E-01 | 1.4E-01 | Normal | 0.01 |
| 7440-50-8 | Copper | 1.0E+00 | 22 | 22 | 5.7E+01 | 3.0E+01 | 3.5E+01 | Normal | 1 |
| 7440-02-0 | Nickel | 1.0E-02 | 22 | 22 | 4.5E+01 | 2.2E+01 | 2.5E+01 | Normal | 0.01 |
| 7439-92-1 | Lead | 1.0E+00 | 22 | 22 | 7.0E+01 | 3.2E+01 | 3.8E+01 | Normal | 1 |
| 7439-98-7 | Molybdenum | 1.0E+00 | 22 | 17 | 3.1E+00 | 1.1E+00 | 1.3E+00 | Normal | 1 |
| 7782-49-2 | Selenium | 1.0E-02 | 22 | 20 | 4.0E+00 | 2.3E+00 | 2.7E+00 | Normal | 0.01 |
| 7440-24-6 | Strontium | 1.0E-02 | 22 | 22 | 1.8E+02 | 7.9E+01 | 9.6E+01 | Normal | 0.01 |
| 7440-61-1 | Uranium | 1.0E-02 | 22 | 22 | 3.5E+00 | 1.7E+00 | 2.0E+00 | Normal | 0.01 |
| 7440-62-2 | Vanadium | 1.0E-01 | 22 | 22 | 1.3E+02 | 7.6E+01 | 8.7E+01 | Normal | 0.1 |
| 7440-66-6 | Zinc | 1.0E+00 | 22 | 22 | 5.9E+02 | 1.8E+02 | 2.1E+02 | Normal | 1 |

95%
UCL Percentage

UCL Percentile

95%

*Analytical Data (Up to 50 Data Points)*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| Sample Name | Neds 1 | Neds 2 | Neds 3 | Neds 4 | Neds 5 | Neds 1QA | Neds 2Qa | Neds3QA | Pond 2 1 | Pond2 2 | Pond2 3 | Pond2 4 | Pond2 5 | Pond2QA1 | Pond2QA2 | Pond2QA3 | Marsh1 | Marsh2 | Marsh1 | Marsh2 | Marsh1 | Marsh2 |
| Date Sampled | | | | | | | | | | | | | | | | | | | | | | |
| 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | nd | 0.01 | nd | 0.01 | 0.01 | nd | 0.01 | nd | nd | nd | nd | 0.1 | nd | nd | nd | nd | nd |
| 43500 | 18100 | 21900 | 31700 | 27500 | 37300 | 13000 | 13000 | 42500 | 35500 | 62400 | 48500 | 25600 | 43500 | 14000 | 14000 | 42300 | 16800 | 66900 | 64300 | 15000 | 13000 |
| 13000 | | | | | | | | 14000 | | | | | | | | 15000 | 13000 | | | | |
| 0.01 | 0.02 | 0.01 | 0.01 | 0.02 | nd | 0.01 | 0.01 | nd | nd | 0.01 | 0.01 | nd | nd | 0.01 | 0.01 | 0.14 | nd | 0.01 | 0.03 | nd | nd |
| 292 | 134 | 160 | 206 | 196 | 222 | 92 | 208 | 283 | 295 | 361 | 312 | 178 | 259 | 100 | 297 | 166 | 77 | 314 | 374 | 13 | 14 |
| 0.08 | 0.11 | 0.06 | 0.11 | 0.07 | nd | 0.09 | 0.04 | 0.02 | 0.05 | 0.07 | 0.06 | 0.02 | nd | 0.04 | 0.03 | 0.87 | 0.2 | 0.03 | 0.06 | nd | nd |
| 0.03 | 0.04 | 0.01 | 0.03 | 0.02 | nd | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | nd | 0.01 | nd | 0.01 | nd | 0.23 | 0.04 | nd | 0.01 | nd | nd |
| 0.14 | 0.16 | 0.09 | 0.17 | 0.15 | nd | 0.14 | 0.05 | 0.03 | 0.06 | 0.06 | 0.09 | 0.03 | nd | 0.05 | 0.04 | 0.91 | 0.25 | 0.02 | 0.03 | nd | nd |
| 0.11 | 0.12 | 0.06 | 0.1 | 0.1 | nd | 0.11 | 0.04 | 0.03 | 0.06 | 0.07 | 0.07 | 0.02 | nd | 0.04 | 0.02 | 0.69 | 0.22 | 0.01 | 0.02 | nd | nd |
| 1.2 | 0.7 | 0.7 | 0.7 | 0.8 | 1.2 | 1.1 | 1.2 | 0.8 | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | nd | 1 | 0.9 | 0.1 | 0.2 | 0.15 | 0.15 |
| 0.04 | 0.08 | 0.02 | 0.03 | 0.04 | nd | 0.05 | 0.02 | 0.01 | 0.02 | 0.03 | 0.03 | 0.01 | nd | 0.02 | 0.01 | 0.28 | 0.09 | 0.01 | 0.02 | nd | nd |
| 0.06 | 0.07 | 0.03 | 0.07 | 0.06 | nd | 0.05 | 0.03 | 0.01 | 0.03 | 0.04 | 0.04 | 0.02 | nd | 0.02 | 0.02 | 0.44 | 0.14 | 0.01 | 0.01 | nd | nd |
| 0.05 | 0.06 | 0.02 | 0.06 | 0.05 | nd | 0.06 | 0.03 | 0.01 | 0.03 | 0.04 | 0.04 | 0.01 | nd | 0.02 | 0.02 | 0.26 | 0.09 | 0.01 | 0.01 | nd | nd |
| 0.05 | 0.06 | 0.02 | 0.06 | 0.05 | nd | 0.06 | 0.02 | 0.01 | 0.03 | 0.04 | 0.04 | 0.01 | nd | 0.02 | 0.02 | 0.26 | 0.09 | 0.01 | 0.01 | nd | nd |
| 0.05 | nd | 0.02 | 0.07 | 0.07 | nd | 0.06 | nd | nd | nd | 0.03 | 0.02 | nd | nd | 0.03 | nd | 0.26 | nd | 0.01 | 0.01 | nd | nd |
| 0.06 | nd | 0.03 | 0.04 | 0.06 | nd | 0.04 | 0.03 | nd | nd | nd | 0.03 | nd | nd | 0.01 | 0.02 | 0.19 | nd | nd | 0.01 | nd | nd |
| nd | nd | 0.01 | 0.05 | 0.06 | nd | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| 0.1617 | 0.15 | 0.16 | 0.16 | 0.18599 | 0.1956 | 0.16 | 0.188 | 0.0618 | 0.106 | 0.096 | 0.117 | 0.0932 | 0.125 | 0.1 | 0.1 | 0.17 | 0.16 | 0.04 | 0.04 | 0.05 | 0.05 |
| 44 | 17 | 19 | 30 | 31 | 34 | 26 | 46.5 | 24 | 29 | 57 | 44 | 21 | 32 | 27 | 33.1 | 42 | 44 | 17 | 17 | 15 | 12 |
| 35 | 11 | 13 | 23 | 18 | 25 | 16 | 22 | 21 | 25 | 45 | 35 | 16 | 27 | 20 | 26 | 25 | 18 | 22 | 21 | 14 | 13 |
| 59.1 | 31.5 | 28.5 | 37.6 | 53.5 | 53.7 | 54 | 69.9 | 22.5 | 29 | 30.2 | 34.4 | 12 | 27.4 | 27 | 24 | 43 | 28.7 | 10.8 | 11.2 | 6.3 | 6.1 |
| 1.2 | 0.6 | 0.6 | 0.8 | 1.2 | 1 | nd | 2.6 | 0.8 | 0.7 | 1.1 | 1 | 1.4 | 1.1 | nd | nd | 3.1 | 2.3 | 0.7 | 0.8 | nd | nd |
| 3 | 2 | 2 | 2 | 3 | 4 | 2 | 4 | 2 | 3 | 2 | 3 | 3 | 4 | 2 | 3 | 2 | 1 | 1 | 2 | nd | nd |
| 84 | 60 | 75 | 84 | 85 | 70 | 27 | 76 | 121 | 97 | 86 | 85 | 63 | 80 | 27 | 126 | 61 | 43 | 183 | 183 | 6 | 6 |
| 2.2 | 1.8 | 1.9 | 2.4 | 3.5 | 2.5 | 2.1 | 2.5 | 1.4 | 1.4 | 1.8 | 1.9 | 2 | 1.8 | 1.5 | 1.7 | 1.2 | 0.5 | 1 | 1 | 0.3 | 0.3 |
| 98 | 140 | 51 | 66 | 63 | 73 | 41 | 109.5 | 72 | 78 | 109 | 94 | 59 | 77 | 44 | 83.6 | 131 | 58 | 129 | 115 | 45 | 41 |
| 250 | 104 | 101 | 128 | 169 | 194 | 160 | 209.2 | 145 | 177 | 156 | 177 | 136 | 184 | 140 | 122.1 | 556 | 274 | 150 | 142 | 100 | 120 |

**SCREEN 7.2 SEDIMENT CONCENTRATION CALCULATOR**

Site Name: Stephenville UAS
Site Location: Stephenville, Newfoundland

Completed By: Alison Denning
Date Completed: 7/2/2010



## TIER 2 SEDIMENT CONCENTRATION DATA SUMMARY

| CONSTITUENTS DETECTED | | Analytical Method | | | Detected Concentrations | | | Calculated Distribution of Data | Default Detection Limit (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| CAS No. | Name | Typical Detection Limit (mg/kg) | No. of Samples | No. of Detects | Maximum Conc. (mg/kg) | Mean Conc. (mg/kg) | UCL on Mean Conc. (mg/kg) | | |
| 83-32-9 | Acenaphthene | 1.0E-02 | 22 | 10 | 1.0E-01 | 7.6E-03 | 9.7E-03 | Lognormal | 0.01 |
| 7429-90-5 | Aluminum | 1.0E+00 | 22 | 22 | 6.7E+04 | 3.2E+04 | 3.9E+04 | Normal | 1 |
| 7429-90-5 | Aluminum (available) | 1.0E+00 | 4 | 4 | 1.5E+04 | 1.4E+04 | 1.5E+04 | Normal | 1 |
| 86-73-7 | Fluorene | 1.0E-02 | 22 | 14 | 1.4E-01 | 9.8E-03 | 1.3E-02 | Lognormal | 0.01 |
| 7440-39-3 | Barium | 1.0E-02 | 22 | 22 | 3.8E+02 | 2.1E+02 | 2.5E+02 | Normal | 0.01 |
| 29-59-3 | Phenanthrene | 1.0E-02 | 22 | 18 | 8.7E-01 | 4.1E-02 | 6.7E-02 | Lognormal | 0.01 |
| 120-12-7 | Anthracene | 1.0E-02 | 22 | 15 | 2.3E-01 | 1.2E-02 | 1.8E-02 | Lognormal | 0.01 |
| 206-44-0 | Fluoranthene | 1.0E-02 | 22 | 18 | 9.1E-01 | 5.1E-02 | 8.5E-02 | Lognormal | 0.01 |
| 129-00-0 | Pyrene | 1.0E-02 | 22 | 18 | 6.9E-01 | 3.9E-02 | 6.4E-02 | Lognormal | 0.01 |
| 7440-43-9 | Cadmium | 1.0E-02 | 22 | 21 | 1.2E+00 | 7.0E-01 | 8.4E-01 | Normal | 0.01 |
| 56-55-3 | Benzo(a)anthracene | 1.0E-02 | 22 | 18 | 2.8E-01 | 2.0E-02 | 3.0E-02 | Lognormal | 0.01 |
| 218-01-9 | Chrysene | 1.0E-02 | 22 | 18 | 4.4E-01 | 2.6E-02 | 4.0E-02 | Lognormal | 0.01 |
| 205-99-2 | Benzo(b)fluoranthene | 1.0E-02 | 22 | 18 | 2.6E-01 | 2.3E-02 | 3.5E-02 | Lognormal | 0.01 |
| 207-08-9 | Benzo(k)fluoranthene | 1.0E-02 | 22 | 18 | 2.6E-01 | 2.3E-02 | 3.4E-02 | Lognormal | 0.01 |
| 50-32-8 | Benzo(a)pyrene | 1.0E-02 | 22 | 11 | 2.8E-01 | 1.3E-02 | 2.1E-02 | Lognormal | 0.01 |
| 193-39-5 | Indeno(1,2,3-cd)pyrene | 1.0E-02 | 22 | 11 | 1.9E-01 | 1.3E-02 | 2.0E-02 | Lognormal | 0.01 |
| 53-70-3 | Dibenz(a,h)anthracene | 1.0E-02 | 22 | 4 | 6.0E-02 | 6.6E-03 | 8.6E-03 | Lognormal | 0.01 |
| 7439-97-6 | Mercury | 1.0E-02 | 22 | 22 | 2.0E-01 | 1.2E-01 | 1.4E-01 | Normal | 0.01 |
| 7440-50-8 | Copper | 1.0E+00 | 22 | 22 | 5.7E+01 | 3.0E+01 | 3.5E+01 | Normal | 1 |
| 7440-02-0 | Nickel | 1.0E-02 | 22 | 22 | 4.5E+01 | 2.2E+01 | 2.5E+01 | Normal | 0.01 |
| 7439-92-1 | Lead | 1.0E+00 | 22 | 22 | 7.0E+01 | 3.2E+01 | 3.8E+01 | Normal | 1 |
| 7439-98-7 | Molybdenum | 1.0E+00 | 22 | 17 | 3.1E+00 | 1.1E+00 | 1.3E+00 | Normal | 1 |
| 7782-49-2 | Selenium | 1.0E-02 | 22 | 20 | 4.0E+00 | 2.3E+00 | 2.7E+00 | Normal | 0.01 |
| 7440-24-6 | Strontium | 1.0E-02 | 22 | 22 | 1.8E+02 | 7.9E+01 | 9.6E+01 | Normal | 0.01 |
| 7440-61-1 | Uranium | 1.0E-02 | 22 | 22 | 3.5E+00 | 1.7E+00 | 2.0E+00 | Normal | 0.01 |
| 7440-62-2 | Vanadium | 1.0E-01 | 22 | 22 | 1.3E+02 | 7.6E+01 | 8.7E+01 | Normal | 0.1 |
| 7440-66-6 | Zinc | 1.0E+00 | 22 | 22 | 5.9E+02 | 1.8E+02 | 2.1E+02 | Normal | 1 |

95%
UCL Percentage

UCL Percentile

95%

*Analytical Data (Up to 50 Data Points)*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| Sample Name | Neds 1 | Neds 2 | Neds 3 | Neds 4 | Neds 5 | Neds 1QA | Neds 2QA | Neds3QA | Pond 2 1 | Pond2 2 | Pond2 3 | Pond2 4 | Pond2 5 | Pond2QA1 | Pond2QA2 | Pond2QA3 | Marsh1 | Marsh2 | Marsh1 | Marsh2 | Marsh1 | Marsh2 |
| Date Sampled | | | | | | | | | | | | | | | | | | | | | | |
| | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | nd | 0.01 | nd | 0.01 | 0.01 | nd | 0.01 | nd | nd | nd | nd | 0.1 | nd | nd | nd | nd | nd |
| | 43500 | 16100 | 21900 | 31700 | 27500 | 37300 | 13000 | 13000 | 42500 | 35600 | 62400 | 48500 | 25800 | 43500 | 14000 | 14000 | 42300 | 16900 | 66900 | 64300 | 15000 | 13000 |
| | 13000 | | | | | | | | 14000 | | | | | | | | 15000 | 13000 | | | | |
| | 0.01 | 0.02 | 0.01 | 0.01 | 0.02 | nd | 0.01 | 0.01 | nd | nd | 0.01 | 0.01 | nd | nd | 0.01 | 0.01 | 0.14 | nd | 0.01 | 0.03 | nd | nd |
| | 292 | 134 | 160 | 206 | 196 | 222 | 92 | 206 | 283 | 295 | 381 | 312 | 178 | 259 | 100 | 287 | 166 | 77 | 314 | 374 | 13 | 14 |
| | 0.08 | 0.11 | 0.06 | 0.11 | 0.07 | nd | 0.09 | 0.04 | 0.02 | 0.05 | 0.07 | 0.06 | 0.02 | nd | 0.04 | 0.03 | 0.87 | 0.2 | 0.03 | 0.08 | nd | nd |
| | 0.03 | 0.04 | 0.01 | 0.03 | 0.02 | nd | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | nd | 0.01 | nd | 0.01 | nd | 0.23 | 0.04 | nd | 0.01 | nd | nd |
| | 0.14 | 0.16 | 0.09 | 0.17 | 0.15 | nd | 0.14 | 0.06 | 0.03 | 0.08 | 0.08 | 0.09 | 0.03 | nd | 0.05 | 0.04 | 0.91 | 0.25 | 0.02 | 0.03 | nd | nd |
| | 0.11 | 0.12 | 0.06 | 0.1 | 0.1 | nd | 0.11 | 0.04 | 0.03 | 0.06 | 0.07 | 0.07 | 0.02 | nd | 0.04 | 0.02 | 0.69 | 0.22 | 0.01 | 0.02 | nd | nd |
| | 1.2 | 0.7 | 0.7 | 0.7 | 0.8 | 1.2 | 1.1 | 1.2 | 0.6 | 0.9 | 0.6 | 0.8 | 0.8 | 0.8 | 0.8 | nd | 1 | 0.9 | 0.1 | 0.2 | 0.15 | 0.15 |
| | 0.04 | 0.06 | 0.02 | 0.03 | 0.04 | nd | 0.05 | 0.02 | 0.01 | 0.02 | 0.03 | 0.03 | 0.01 | nd | 0.02 | 0.01 | 0.28 | 0.09 | 0.01 | 0.02 | nd | nd |
| | 0.06 | 0.07 | 0.03 | 0.07 | 0.06 | nd | 0.06 | 0.03 | 0.01 | 0.03 | 0.04 | 0.04 | 0.02 | nd | 0.02 | 0.02 | 0.44 | 0.14 | 0.01 | 0.01 | nd | nd |
| | 0.05 | 0.06 | 0.02 | 0.06 | 0.05 | nd | 0.06 | 0.03 | 0.01 | 0.03 | 0.04 | 0.04 | 0.01 | nd | 0.02 | 0.02 | 0.26 | 0.09 | 0.01 | 0.01 | nd | nd |
| | 0.05 | 0.06 | 0.02 | 0.06 | 0.05 | nd | 0.06 | 0.02 | 0.01 | 0.03 | 0.04 | 0.04 | 0.01 | nd | 0.02 | 0.02 | 0.28 | 0.09 | 0.01 | 0.01 | nd | nd |
| | 0.05 | nd | 0.02 | 0.07 | 0.07 | nd | 0.06 | nd | nd | nd | 0.03 | 0.02 | nd | nd | 0.03 | nd | 0.28 | nd | 0.01 | 0.01 | nd | nd |
| | 0.06 | nd | 0.03 | 0.04 | 0.06 | nd | 0.04 | 0.03 | nd | nd | nd | 0.03 | nd | nd | 0.01 | 0.02 | 0.19 | nd | nd | 0.01 | nd | nd |
| | nd | nd | 0.01 | 0.05 | 0.06 | nd | 0.01 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| | 0.1817 | 0.15 | 0.16 | 0.16 | 0.16569 | 0.1956 | 0.16 | 0.168 | 0.0818 | 0.106 | 0.096 | 0.117 | 0.0932 | 0.125 | 0.1 | 0.1 | 0.17 | 0.16 | 0.04 | 0.04 | 0.05 | 0.05 |
| | 44 | 17 | 19 | 30 | 31 | 34 | 28 | 46.5 | 24 | 29 | 57 | 44 | 21 | 32 | 27 | 33.1 | 42 | 44 | 17 | 17 | 15 | 12 |
| | 35 | 11 | 13 | 23 | 18 | 25 | 18 | 22 | 21 | 25 | 45 | 35 | 16 | 27 | 20 | 26 | 25 | 18 | 22 | 21 | 14 | 13 |
| | 59.1 | 31.5 | 28.5 | 37.8 | 53.5 | 53.7 | 54 | 60.9 | 22.5 | 29 | 30.2 | 34.4 | 12 | 27.4 | 27 | 24 | 43 | 28.7 | 10.8 | 11.2 | 6.3 | 6.1 |
| | 1.2 | 0.6 | 0.6 | 0.8 | 1.2 | 1 | nd | 2.8 | 0.8 | 0.7 | 1.1 | 1 | 1.4 | 1.1 | nd | nd | 3.1 | 2.3 | 0.7 | 0.8 | nd | nd |
| | 3 | 2 | 2 | 2 | 3 | 4 | 2 | 4 | 2 | 3 | 2 | 3 | 3 | 4 | 2 | 3 | 2 | 1 | 1 | 2 | nd | nd |
| | 84 | 60 | 75 | 84 | 85 | 79 | 27 | 76 | 121 | 97 | 88 | 85 | 63 | 80 | 27 | 128 | 61 | 43 | 183 | 183 | 6 | 6 |
| | 2.2 | 1.8 | 1.9 | 2.4 | 3.5 | 2.5 | 2.1 | 2.5 | 1.4 | 1.4 | 1.8 | 1.9 | 2 | 1.8 | 1.5 | 1.7 | 1.2 | 0.5 | 1 | 1 | 0.3 | 0.3 |
| | 96 | 40 | 51 | 66 | 63 | 73 | 41 | 109.5 | 72 | 75 | 109 | 94 | 59 | 77 | 44 | 83.8 | 131 | 58 | 129 | 115 | 45 | 41 |
| | 250 | 104 | 101 | 126 | 169 | 194 | 160 | 209.2 | 145 | 177 | 156 | 177 | 139 | 164 | 140 | 122.1 | 595 | 274 | 150 | 142 | 100 | 120 |

[redacted] Completed By: Allison Denning

Site Location: Stephenville, Newfoundland Date Completed: 7/1/2006

## TIER 2 SURFACE WATER CONCENTRATION DATA SUMMARY

| CONSTITUENTS DETECTED | | | Analytical Method | | | Detected Concentrations | | |
|---|---|---|---|---|---|---|---|---|
| CAS No. | Name | | Typical Detection Limit (ug/L or mg/L) | No. of Samples | No. of Detects | Maximum Conc. (ug/L or mg/L) | Mean Conc. (ug/L or mg/L) | UCL on Mean Conc. (ug/L or mg/L) |
| 7429-90-5 | Aluminum | ug/L | 1.0E+00 | 10 | 10 | 1.1E+02 | 8.6E+01 | 9.6E+01 |
| 7440-39-3 | Barium | ug/L | 1.0E+00 | 10 | 10 | 2.9E+01 | 1.7E+01 | 1.9E+01 |
| 7440-43-9 | Cadmium | ug/L | 1.0E-01 | 10 | 2 | 2.0E-01 | 7.0E-02 | 9.8E-02 |
| 7440-50-8 | Copper | ug/L | 1.0E+00 | 10 | 8 | 1.2E+01 | 1.2E+00 | 2.0E+00 |
| | Iron | ug/L | 1.0E+00 | 10 | 10 | 1.8E+02 | 1.7E+02 | 1.8E+02 |
| 7439-92-1 | Lead | ug/L | 1.0E+00 | 10 | 10 | 5.3E+00 | 5.3E+00 | 3.1E+00 |
| 7439-98-7 | Molybdenum | ug/L | 1.0E-02 | 10 | 2 | 1.0E-01 | 1.0E-01 | 1.9E-02 |
| 7440-02-0 | Nickel | ug/L | 1.0E+00 | 10 | 1 | 2.0E+00 | 6.5E-01 | 9.2E-01 |
| 7782-49-2 | Selenium | ug/L | 1.0E+00 | 10 | 2 | 1.0E+00 | 6.0E-01 | 7.2E-01 |
| 7440-24-6 | Strontium | ug/L | 1.0E-01 | 10 | 10 | 9.4E+01 | 4.9E+01 | 5.9E+01 |
| 7440-61-1 | Uranium | ug/L | 1.0E-01 | 10 | 1 | 2.0E-01 | 6.5E-02 | 9.2E-02 |
| 7440-66-6 | Zinc | ug/L | 1.0E+00 | 10 | 10 | 2.9E+01 | 4.5E+00 | 6.9E+00 |
| 7439-97-6 | Mercury | ug/L | 5.0E-02 | 10 | 5 | 4.0E-01 | 5.7E-02 | 1.0E-01 |
| 7440-23-5 | Sodium | mg/L | 1.0E+00 | 10 | 10 | 3.2E+01 | 2.9E+01 | 3.0E+01 |
| 2023-69-5 | Potassium | mg/L | 1.0E-01 | 10 | 10 | 7.4E-01 | 7.0E-01 | 7.2E-01 |
| 7440-70-2 | Calcium | mg/L | 1.0E+00 | 10 | 10 | 2.8E+01 | 2.6E+01 | 2.7E+01 |
| 7439-95-4 | Magnesium | mg/L | 1.0E+00 | 10 | 10 | 6.5E+00 | 6.1E+00 | 6.3E+00 |
| 7664-41-7 | Ammonia | mg/L | 5.0E-02 | 10 | 1 | 5.0E-02 | 2.8E-02 | 3.2E-02 |
| No CAS | Chloride | mg/L | 1.0E+00 | 10 | 10 | 5.2E+01 | 4.9E+01 | 5.0E+01 |
| No CAS | Sulfate | mg/L | 1.0E+00 | 10 | 10 | 4.9E+00 | 4.2E+00 | 4.4E+00 |
| No CAS | Nitrate/Nitrite | mg/L | 5.0E-02 | 10 | 7 | 1.7E-01 | 9.5E-02 | 1.3E-01 |
| No CAS | 0-Phosphate | mg/L | 1.0E-02 | 10 | 1 | 1.0E-01 | 6.7E-03 | 1.2E-02 |
| No CAS | r-Silica | mg/L | 1.0E+00 | 10 | 10 | 4.7E+00 | 4.5E+00 | 4.6E+00 |
| No CAS | TOC | mg/L | 1.0E+00 | 10 | 10 | 1.2E+01 | 1.1E+01 | 1.1E+01 |
| No CAS | Turbidity | mg/L | 1.0E-01 | 10 | 10 | 1.6E+00 | 1.3E+00 | 1.4E+00 |
| No CAS | Conductivity | mg/L | 1.0E+00 | 10 | 10 | 3.3E+02 | 3.1E+02 | 3.2E+02 |
| | | | | | | | | 95% |
| | | | | | | | | UCL Percentage |

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Software: GSI RBCA Spreadsheet -Atlantic Canada
Version: 1.0a

Choose UCL Percentile

95%

Analytical Data (Up to 50 Data Points)

***Analytical Data (Up to 50 Data Points)***

| Calculated Distribution of Data | Default Detection Limit (mg/L) |
|---|---|
| Normal | 1 |
| Normal | 1 |
| Normal | 0.1 |
| Lognormal | 1 |
| Normal | 1 |
| Normal | 1 |
| Lognormal | 0.01 |
| Normal | 1 |
| Normal | 1 |
| Normal | 0.1 |
| Normal | 0.1 |
| Lognormal | 1 |
| Lognormal | 0.05 |
| Normal | 1 |
| Normal | 0.1 |
| Normal | 1 |
| Normal | 1 |
| Normal | 0.05 |
| Normal | 1 |
| Normal | 1 |
| Normal | 0.05 |
| Lognormal | 0.01 |
| Normal | 1 |
| Normal | 1 |
| Normal | 0.1 |
| Normal | 1 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) |
| **Sample Name** | Neds1 | Neds2 | Neds3 | Neds4 | Neds5 | Pond2 1 | Pond2 2 | Pond2 3 | Pond2 4 | Pond2 5 |
| **Date Sampled** | | | | | | | | | | |
| | 88 | 87 | 99 | 89 | 93 | 40 | 87 | 105 | 82 | 88 |
| | 14 | 16 | 15 | 15 | 15 | 29 | 15 | 16 | 16 | 16 |
| | nd | nd | nd | nd | nd | 0.1 | nd | nd | nd | 0.2 |
| | nd | nd | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 12 |
| | 180 | 180 | 180 | 180 | 180 | 110 | 170 | 160 | 150 | 160 |
| | 1.2 | 0.3 | 1.6 | 0.6 | 1.4 | 0.3 | 3.4 | 5.3 | 3.4 | 3.3 |
| | nd | nd | nd | nd | nd | 0.1 | nd | 0.1 | nd | nd |
| | nd | nd | nd | nd | nd | nd | nd | nd | nd | 2 |
| | 1 | nd | nd | nd | nd | nd | nd | nd | 1 | nd |
| | 40 | 43 | 44 | 44 | 43 | 94 | 46 | 47 | 47 | 46 |
| | nd | nd | nd | nd | nd | 0.2 | nd | nd | nd | nd |
| | 3 | 2 | 4 | 3 | 5 | 3 | 6 | 5 | 4 | 29 |
| | nd | nd | nd | nd | nd | 0.1 | 0.1 | 0.1 | 0.1 | 0.4 |
| | 26.4 | 28.8 | 28.5 | 29 | 28.8 | 31.9 | 29.8 | 29.3 | 29.3 | 29.1 |
| | 0.66 | 0.72 | 0.74 | 0.73 | 0.73 | 0.66 | 0.73 | 0.67 | 0.69 | 0.66 |
| | 24.1 | 25.7 | 28.5 | 25.9 | 26.8 | 27.3 | 26.2 | 26.9 | 26.8 | 26.8 |
| | 5.66 | 5.88 | 6.08 | 6.42 | 5.97 | 6 | 6.16 | 6.4 | 6.46 | 6.34 |
| | nd | nd | nd | nd | nd | 0.05 | nd | nd | nd | nd |
| | 45.8 | 48.5 | 48.7 | 49.7 | 49.4 | 51.7 | 49.8 | 50.1 | 49.1 | 49.6 |
| | 3.8 | 4.4 | 3.8 | 3.7 | 3.8 | 4.6 | 4.3 | 4.9 | 4.1 | 4.2 |
| | 0.09 | nd | nd | nd | nd | 0.06 | 0.13 | 0.13 | 0.17 | 0.16 |
| | nd | nd | nd | nd | nd | 0.1 | nd | nd | nd | nd |
| | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.7 | 4.6 | 4.6 | 4.6 | 4.6 |
| | 11.8 | 12.2 | 12.1 | 12.1 | 12.2 | 9.1 | 9.3 | 9 | 9 | 8.9 |
| | 1.34 | 1.21 | 1.47 | 1.02 | 1.13 | 0.9 | 1.25 | 0.82 | 1.3 | 1.49 |
| | 291 | 309 | 310 | 306 | 303 | 327 | 314 | 318 | 324 | 324 |

Completed By: Allison Denning

Site Location: Stephenville, Newfoundland  Date Completed: 7/1/2006

## TIER 2 SURFACE WATER CONCENTRATION DATA SUMMARY

| CONSTITUENTS DETECTED | | | Analytical Method | | | Detected Concentrations | | |
|---|---|---|---|---|---|---|---|---|
| CAS No. | Name | | Typical Detection Limit (ug/L or mg/L) | No. of Samples | No. of Detects | Maximum Conc. (ug/L or mg/L) | Mean Conc. (ug/L or mg/L) | UCL on Mean Conc. (ug/L or mg/L) |
| 7429-90-5 | Aluminum | ug/L | 1.0E+00 | 10 | 10 | 1.1E+02 | 8.6E+01 | 9.6E+01 |
| 7440-39-3 | Barium | ug/L | 1.0E+00 | 10 | 10 | 2.9E+01 | 1.7E+01 | 1.9E+01 |
| 7440-43-9 | Cadmium | ug/L | 1.0E-01 | 10 | 2 | 2.0E-01 | 7.0E-02 | 9.8E-02 |
| 7440-50-8 | Copper | ug/L | 1.0E+00 | 10 | 8 | 1.2E+01 | 1.2E+00 | 2.0E+00 |
| | Iron | ug/L | 1.0E+00 | 10 | 10 | 1.8E+02 | 1.7E+02 | 1.8E+02 |
| 7439-92-1 | Lead | ug/L | 1.0E+00 | 10 | 10 | 5.3E+00 | 5.3E+00 | 3.1E+00 |
| 7439-98-7 | Molybdenum | ug/L | 1.0E-02 | 10 | 2 | 1.0E-01 | 1.0E-01 | 1.9E-02 |
| 7440-02-0 | Nickel | ug/L | 1.0E+00 | 10 | 1 | 2.0E+00 | 6.5E-01 | 9.2E-01 |
| 7782-49-2 | Selenium | ug/L | 1.0E+00 | 10 | 2 | 1.0E+00 | 6.0E-01 | 7.2E-01 |
| 7440-24-6 | Strontium | ug/L | 1.0E-01 | 10 | 10 | 9.4E+01 | 4.9E+01 | 5.9E+01 |
| 7440-61-1 | Uranium | ug/L | 1.0E-01 | 10 | 1 | 2.0E-01 | 6.5E-02 | 9.2E-02 |
| 7440-66-6 | Zinc | ug/L | 1.0E+00 | 10 | 10 | 2.9E+01 | 4.5E+00 | 6.9E+00 |
| 7439-97-6 | Mercury | ug/L | 5.0E-02 | 10 | 5 | 4.0E-01 | 5.7E-02 | 1.0E-01 |
| 7440-23-5 | Sodium | mg/L | 1.0E+00 | 10 | 10 | 3.2E+01 | 2.9E+01 | 3.0E+01 |
| 2023-69-5 | Potassium | mg/L | 1.0E-01 | 10 | 10 | 7.4E-01 | 7.0E-01 | 7.2E-01 |
| 7440-70-2 | Calcium | mg/L | 1.0E+00 | 10 | 10 | 2.8E+01 | 2.6E+01 | 2.7E+01 |
| 7439-95-4 | Magnesium | mg/L | 1.0E+00 | 10 | 10 | 6.5E+00 | 6.1E+00 | 6.3E+00 |
| 7664-41-7 | Ammonia | mg/L | 5.0E-02 | 10 | 1 | 5.0E-02 | 2.8E-02 | 3.2E-02 |
| No CAS | Chloride | mg/L | 1.0E+00 | 10 | 10 | 5.2E+01 | 4.9E+01 | 5.0E+01 |
| No CAS | Sulfate | mg/L | 1.0E+00 | 10 | 10 | 4.9E+00 | 4.2E+00 | 4.4E+00 |
| No CAS | Nitrate/Nitrite | mg/L | 5.0E-02 | 10 | 7 | 1.7E-01 | 9.5E-02 | 1.3E-01 |
| No CAS | 0-Phosphate | mg/L | 1.0E-02 | 10 | 1 | 1.0E-01 | 6.7E-03 | 1.2E-02 |
| No CAS | r-Silica | mg/L | 1.0E+00 | 10 | 10 | 4.7E+00 | 4.5E+00 | 4.6E+00 |
| No CAS | TOC | mg/L | 1.0E+00 | 10 | 10 | 1.2E+01 | 1.1E+01 | 1.1E+01 |
| No CAS | Turbidity | mg/L | 1.0E-01 | 10 | 10 | 1.6E+00 | 1.3E+00 | 1.4E+00 |
| No CAS | Conductivity | mg/L | 1.0E+00 | 10 | 10 | 3.3E+02 | 3.1E+02 | 3.2E+02 |
| | | | | | | | | 95% |
| | | | | | | | | UCL Percentage |

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Software: GSI RBCA Spreadsheet -Atlantic Canada
Version: 1.0a

Choose UCL Percentile

95%

Analytical Data (Up to 50 Data Points)

***Analytical Data (Up to 50 Data Points)***

| Calculated Distribution of Data | Default Detection Limit (mg/L) |
|---|---|
| Normal | 1 |
| Normal | 1 |
| Normal | 0.1 |
| Lognormal | 1 |
| Normal | 1 |
| Normal | 1 |
| Lognormal | 0.01 |
| Normal | 1 |
| Normal | 1 |
| Normal | 0.1 |
| Normal | 0.1 |
| Lognormal | 1 |
| Lognormal | 0.05 |
| Normal | 1 |
| Normal | 0.1 |
| Normal | 1 |
| Normal | 1 |
| Normal | 0.05 |
| Normal | 1 |
| Normal | 1 |
| Normal | 0.05 |
| Lognormal | 0.01 |
| Normal | 1 |
| Normal | 1 |
| Normal | 0.1 |
| Normal | 1 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) | (ug/L or mg/L) |
| **Sample Name** | Neds1 | Neds2 | Neds3 | Neds4 | Neds5 | Pond2 1 | Pond2 2 | Pond2 3 | Pond2 4 | Pond2 5 |
| **Date Sampled** | | | | | | | | | | |
| | 88 | 87 | 99 | 89 | 93 | 40 | 87 | 105 | 82 | 88 |
| | 14 | 16 | 15 | 15 | 15 | 29 | 15 | 16 | 16 | 16 |
| | nd | nd | nd | nd | nd | 0.1 | nd | nd | nd | 0.2 |
| | nd | nd | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 12 |
| | 180 | 180 | 180 | 180 | 180 | 110 | 170 | 160 | 150 | 160 |
| | 1.2 | 0.3 | 1.6 | 0.6 | 1.4 | 0.3 | 3.4 | 5.3 | 3.4 | 3.3 |
| | nd | nd | nd | nd | nd | 0.1 | nd | 0.1 | nd | nd |
| | nd | nd | nd | nd | nd | nd | nd | nd | nd | 2 |
| | 1 | nd | nd | nd | nd | nd | nd | nd | 1 | nd |
| | 40 | 43 | 44 | 44 | 43 | 94 | 46 | 47 | 47 | 46 |
| | nd | nd | nd | nd | nd | 0.2 | nd | nd | nd | nd |
| | 3 | 2 | 4 | 3 | 5 | 3 | 6 | 5 | 4 | 29 |
| | nd | nd | nd | nd | nd | 0.1 | 0.1 | 0.1 | 0.1 | 0.4 |
| | 28.4 | 28.8 | 28.5 | 29 | 28.8 | 31.9 | 29.8 | 29.3 | 29.3 | 29.1 |
| | 0.66 | 0.72 | 0.74 | 0.73 | 0.73 | 0.66 | 0.73 | 0.67 | 0.69 | 0.68 |
| | 24.1 | 25.7 | 25.5 | 25.9 | 25.8 | 27.3 | 28.2 | 26.9 | 26.8 | 26.8 |
| | 5.56 | 5.88 | 6.06 | 6.42 | 5.97 | 6 | 6.16 | 6.4 | 6.46 | 6.34 |
| | nd | nd | nd | nd | nd | 0.05 | nd | nd | nd | nd |
| | 45.8 | 48.5 | 48.7 | 49.7 | 49.4 | 51.7 | 49.8 | 50.1 | 49.1 | 49.6 |
| | 3.8 | 4.4 | 3.8 | 3.7 | 3.8 | 4.5 | 4.3 | 4.9 | 4.1 | 4.2 |
| | 0.09 | nd | nd | nd | 0.06 | 0.13 | 0.13 | 0.13 | 0.17 | 0.16 |
| | nd | nd | nd | nd | nd | 0.1 | nd | nd | nd | nd |
| | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.7 | 4.6 | 4.6 | 4.6 | 4.6 |
| | 11.6 | 12.2 | 12.1 | 12.1 | 12.2 | 9.1 | 9.3 | 9 | 9 | 8.9 |
| | 1.34 | 1.21 | 1.47 | 1.62 | 1.13 | 0.9 | 1.25 | 0.89 | 1.3 | 1.49 |
| | 291 | 309 | 310 | 308 | 303 | 327 | 314 | 318 | 324 | 324 |